# The CRUSHED STONE JOURNAL

PUBLISHED QUARTERLY

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First Convention of Agricultural Limestone Division a Huge Success

Postwar Construction Outlook

Agricultural Limestone and Its Place in A.A.A.'s Postwar Program

The National Crushed Stone Association Safety Competition of 1944

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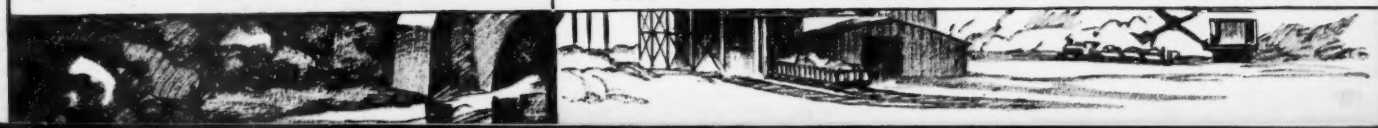
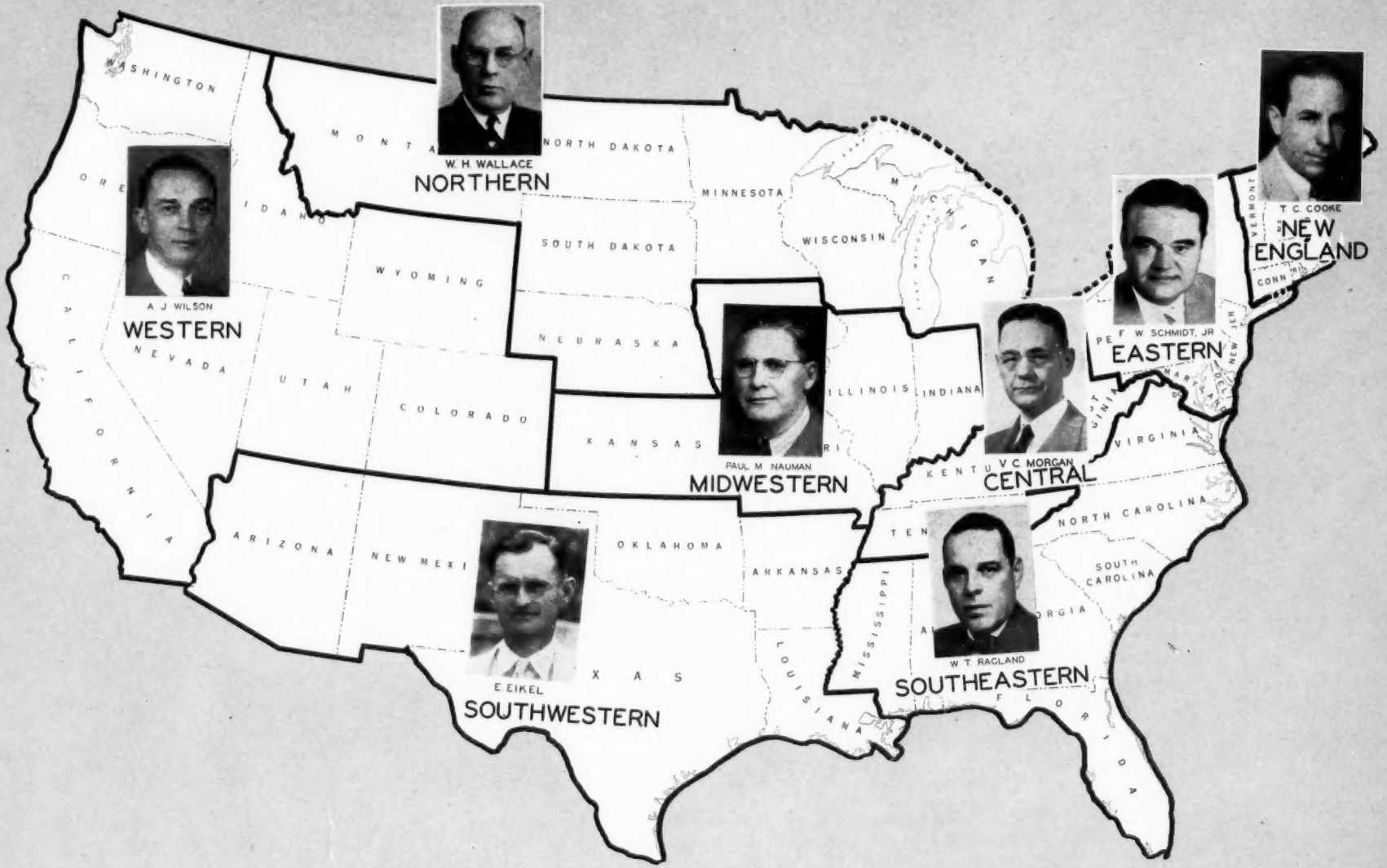
March · 1946

Official Publication

NATIONAL CRUSHED STONE ASSOCIATION

**MAP SHOWING REGIONS AND REGIONAL VICE PRESIDENTS FOR 1946**
**NATIONAL CRUSHED STONE ASSOCIATION**



# The Crushed Stone Journal

Official Publication of the NATIONAL CRUSHED STONE ASSOCIATION

J. R. BOYD, Editor

NATIONAL CRUSHED STONE ASSOCIATION

1735 14th St., N. W.
Washington 9, D. C.

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V. C. MORGAN — W. H. WALLACE
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S. P. MOORE — STIRLING TOMKINS
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**G. A. AUSTIN**
President
Consolidated Quarries Corp.,
Decatur, Georgia

●

Elected President
NATIONAL CRUSHED STONE ASSOCIATION
at its 29th Annual Convention,
Cincinnati, Ohio
January 28-30, 1946

# THE CRUSHED STONE JOURNAL

WASHINGTON, D. C.

Vol. XXII No. 1 PUBLISHED QUARTERLY MARCH, 1946


# Twenty-Ninth Annual Convention Proves Outstandingly Successful

## G. A. AUSTIN Elected President — J. B. TERBELL Becomes Chairman of Manufacturers' Division

TO the nearly five hundred delegates attending the 29th Annual Convention of the National Crushed Stone Association, held in Cincinnati, Ohio, on January 28, 29 and 30, 1946, it was clearly evident that the crushed stone industry is keenly aware of the many problems which will confront it during the postwar period and that only through intelligent organized effort can these problems adequately be solved. From the opening session on Monday morning through the concluding sessions on Wednesday afternoon interest in the various speakers and discussions was sustained at a level certainly not exceeded at any previous convention. Notable was the promptness with which sessions began and the large numbers in attendance at each.

No attempt is made here to give the highlights of the meeting because space limitations do not permit a complete, detailed account, and to mention some and not others would be an injustice to those omitted. The papers of outstanding interest and permanent value will be published in the Crushed Stone Journal or printed for direct distribution.

### Election of Officers and Board of Directors

The annual election of officers and Board of Directors was held on Tuesday morning, January 29, 1946. The report of the Nominating Committee was presented by its Chairman, Wm. M. Andrews, and resulted in the unanimous election of the members of the Board and Regional Vice Presidents (ex-officio members of the Board), as listed below. Members newly elected to the Board include the following: H. H. Brandon, H. N. Clark, N. E. Kelb, V. C. Morgan, W. R. Sanborn, A. T. Smith and Stirling Tomkins. Mr. Tomkins, formerly a member of the Board, served as an honorary member while he was absent overseas during the war.

### Board of Directors

G. A. Austin, *Chairman,* Consolidated Quarries Corp., Decatur, Ga.
Wm. M. Andrews, Union Limestone Co., New Castle, Pa.
L. J. Boxley, Blue Ridge Stone Corp., Roanoke, Va.
H. H. Brandon, Melvin Stone Co., Melvin, Ohio
J. E. Bryan, Bryan-Monroe Co., Raleigh, N. C.
J. Reid Callanan, Callanan Road Improvement Co., South Bethlehem, N. Y.
W. N. Carter, National Stone Co., Joliet, Ill.
A. J. Cayia, Inland Lime and Stone Co., Manistique, Mich.
H. N. Clark, Dolomite Products Co., Inc., Rochester, N. Y.
T. C. Cooke, Lynn Sand & Stone Co., Swampscott, Mass.
F. O. Earnshaw, Carbon Limestone Co., Youngstown, Ohio
Arthur F. Eggleston, John S. Lane & Son, Inc., Meriden, Conn.
E. Eikel, Servtex Materials Co., New Braunfels, Texas
Otho M. Graves, General Crushed Stone Co., Easton, Pa.
G. F. Hammerschmidt, Elmhurst-Chicago Stone Co., Elmhurst, Ill.

G. A. AUSTIN, Chairman,
Consolidated Quarries Corp.,
Decatur, Ga.

F. O. EARNSHAW
Carbon Limestone Co.,
Youngstown, Ohio

OTHO M. GRAVES
General Crushed Stone
Co., Easton, Pa.

# EXECUTIVE COMMITTEE

**of the**

**NATIONAL CRUSHED STONE ASSOCIATION**

**elected by the Board of Directors at its meeting in**

**Cincinnati, Ohio, January 30, 1946**

S. P. MOORE
Concrete Materials
and Construction Co.,
Cedar Rapids, Iowa,
Representing the Agri-
cultural Limestone
Division

J. B. TERBELL
American Manganese
Steel Division,
American Brake Shoe
Co., New York, N.Y.,
Representing the Man-
ufacturers' Division

RUSSELL RAREY
Marble Cliff Quarries
Co., Columbus, Ohio

F. W. SCHMIDT, JR.
North Jersey Quarry
Co., Morristown, N. J.

STIRLING TOMKINS
New York Trap Rock
Corp., New York, N.Y.

W. F. WISE,
Southwest Stone Co.,
Dallas, Texas

A. L. WORTHEN
New Haven Trap Rock
Co., New Haven,
Conn.

## AMONG NEWLY ELECTED MEMBERS OF BOARD

H. H. BRANDON
Melvin Stone Co.,
Melvin, Ohio

H. N. CLARK
Dolomite Products
Co., Inc.,
Rochester, N. Y.

N. E. KELB
Cumberland Quarries,
Inc., Indianapolis,
Ind.

V. C. MORGAN
Kentucky Stone Co.,
Louisville, Ky.

A. T. SMITH
Rock Hill Quarries
Co., St. Louis, Mo.

## NEWLY ELECTED HONORARY MEMBERS

JOHN C. GALL
Washington, D. C.

JOHN RICE, SR.,
General Crushed
Stone Co., Easton, Pa.

R. G. L. Harstone, Canada Crushed Stone Ltd., Hamilton, Ontario, Can.
J. L. Heimlich, LeRoy Lime & Crushed Stone Corp., LeRoy, N. Y.
R. P. Immel, American Limestone Co., Knoxville, Tenn.
N. E. Kelb, Cumberland Quarries, Inc., Indianapolis, Ind.
E. J. Krause, Columbia Quarry Co., St. Louis, Mo.
J. C. Lauber, Trap Rock Co., Minneapolis, Minn.
M. E. McLean, East St. Louis Stone Co., East St. Louis, Ill.
V. C. Morgan, Kentucky Stone Co., Louisville, Ky.
Paul M. Nauman, Dubuque Stone Products Co., Dubuque, Iowa
W. T. Ragland, Superior Stone Co., Raleigh, N. C.
H. E. Rainer, Federal Crushed Stone Corp., Buffalo, N. Y.
Russell Rarey, Marble Cliff Quarries Co., Columbus, Ohio
J. A. Rigg, Acme Limestone Co., Fort Spring, West Virginia
H. E. Rodes, Franklin Limestone Co., Nashville, Tenn.
W. R. Sanborn, Lehigh Stone Co., Kankakee, Ill.
James Savage, Buffalo Crushed Stone Corp., Buffalo, N. Y.
F. W. Schmidt, Jr., North Jersey Quarry Co., Morristown, N. J.
A. T. Smith, Rock Hill Quarries Co., St. Louis, Mo.
O. M. Stull, Liberty Limestone Corp., Buchanan, Va.
Stirling Tomkins, New York Trap Rock Corp., New York, N. Y.
W. H. Wallace, Wallace Stone Co., Bay Port, Mich.
W. S. Weston, Weston & Brooker Co., Columbia, S. C.
D. L. Williams, Virginian Limestone Corp., Ripplemead, Va.
A. J. Wilson, Granite Rock Co., Watsonville, Calif.
W. F. Wise, Southwest Stone Co., Dallas, Texas
A. L. Worthen, New Haven Trap Rock Co., New Haven, Conn.

### Representatives of the Manufacturers' Division and of the Agricultural Limestone Division on the Board

In accord with the By-Laws, the Manufacturers' Division and the Agricultural Limestone Division are each authorized to designate two representatives as ex-officio members of the National Board, in addition to their respective chairmen.

As a result of the election held at the business meeting of the Manufacturers' Division on Tuesday morning, January 29, 1946, J. B. Terbell, was elected Chairman of the Division and Milo A. Nice and L. W. Shugg were designated to serve with him as ex-officio members of the National Board.

S. P. Moore was elected Chairman of the Agricultural Limestone Division at its annual meeting held on February 1, 1946, and thus became an ex-officio member of the National Board. In addition, the Agricultural Limestone Division Board of Directors, at its meeting on February 1, 1946, designated James

Eells and E. E. Haapala as its other two ex-officio members on the National Board.

### Honorary Members

At the meeting of the Board of Directors of the National Crushed Stone Association, held on January 30, 1946, the following were elected to honorary membership on the National Board: A. J. Blair, John C. Gall, John Rice, Sr., and Harold Williams.

JAMES SAVAGE
Buffalo Crushed Stone Corp., Buffalo, N. Y., Re-elected Treasurer

### Regional Vice Presidents

In accord with the recommendations of the Nominating Committee, the following were elected as Regional Vice Presidents for the regions as indicated:

Eastern—F. W. SCHMIDT, JR.
New England—T. C. COOKE
Midwestern—PAUL M. NAUMAN
Southeastern—W. T. RAGLAND
Central—V. C. MORGAN
Northern—W. H. WALLACE
Western—A. J. WILSON
Southwestern—E. EIKEL

### G. A. Austin Elected President

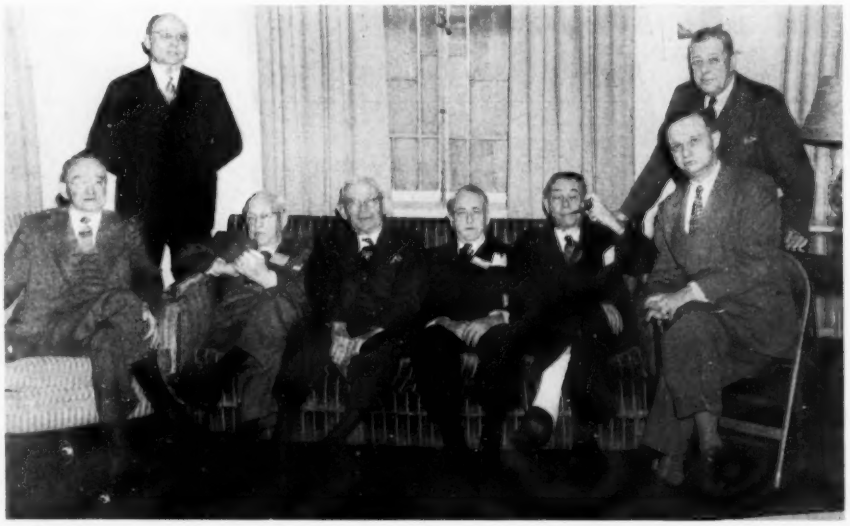
In concluding the report of the Nominating Committee, Mr. Andrews stated that after considering a number of candidates for the high office of President, it was the unanimous decision of the Committee, in view of his recognized outstanding ability and devotion to the Association, to place in nomination the name of G. A. Austin. Chairman Andrews announcement was greeted with enthusiastic applause; the nominations were then closed and the Secretary instructed to cast the unanimous ballot of the convention for the election of Mr. Austin as President.

At the request of President Earnshaw, President-Elect Austin was escorted to the platform by Ex-Presidents Russell Rarey and H. E. Rodes. In a brief speech of acceptance, Mr. Austin expressed his deep and sincere appreciation for the honor conferred upon him and pledged his best efforts to the Association during his administration.

### Tribute to Retiring President, F. O. Earnshaw

As soon as the retiring president, Mr. Earnshaw, had turned the gavel over to President-Elect Austin, Otho M. Graves asked for the privilege of the floor and spoke as follows:

"Mr. President, I cannot let this opportunity pass to say just a word or two that is not related particularly to you. I am thinking about our retiring President and it is interesting for all of us to observe that in the somewhat over twenty-eight years of life of this Association, we now have living eleven ex-presidents, Mr. Earnshaw being the 15th President, but four being deceased. Of these eleven, eight are here at the convention. The three who are absent include John Rice, E. J. Krause and A. J. Blair. Mr. Blair is no longer in the stone business; Mr. Rice has just had a serious operation and is recuperating in Florida; and Mr. Krause is seriously ill and therefore could not attend. Except for these circumstances, we would have had ten of the eleven living ex-presidents present at this meeting. I submit to you that that is, to my mind, a remarkable tribute



EX-PRESIDENTS PRESENT AT THE 29TH ANNUAL CONVENTION, CINCINNATI, OHIO, JANUARY 28-30, 1946. LEFT TO RIGHT: *Standing:* J. A. RIGG, WM. M. ANDREWS; *Sitting:* W. F. WISE, F. O. EARNSHAW, H. E. RODES, A. L. WORTHEN, OTHO M. GRAVES, RUSSELL RAREY.

to the loyalty of the ex-presidents of this Association, that eight out of eleven are here today after twenty-eight years of life of this organization.

"I am saying this, Mr. Earnshaw, to you particularly because we are all conscious of the admirable manner in which you have discharged the duties of your high office. We are also gratefully aware of the unfailing consideration and courtesy which you have shown to all of us, to the Staff in Washington, to the members of the Board, to the members of the Executive Committee, and to all of the members; and particularly are we aware of your gentle consideration of our conflicting points of view which from time to time arise. I am sure, Mr. Earnshaw, that the ex-presidents who are present will permit me to say on their behalf that, 'We welcome you to our ranks.' "

The audience spontaneously arose and vigorously applauded.

Mr. Earnshaw acknowledged with deep appreciation Mr. Graves' fine tribute and turning to President-Elect Austin said, "I hope and trust and know that with the great spirit of cooperation and constructive help that you will receive from this organization, you are going to be a happy man in your office."

**Board of Directors Elects Executive Committee**

The newly elected Board of Directors met immediately following the conclusion of the convention on Wednesday afternoon and elected the following to the Executive Committee for the ensuing year:

F. O. Earnshaw — F. W. Schmidt, Jr.
Otho M. Graves — Stirling Tomkins
Russell Rarey — W. F. Wise
A. L. Worthen

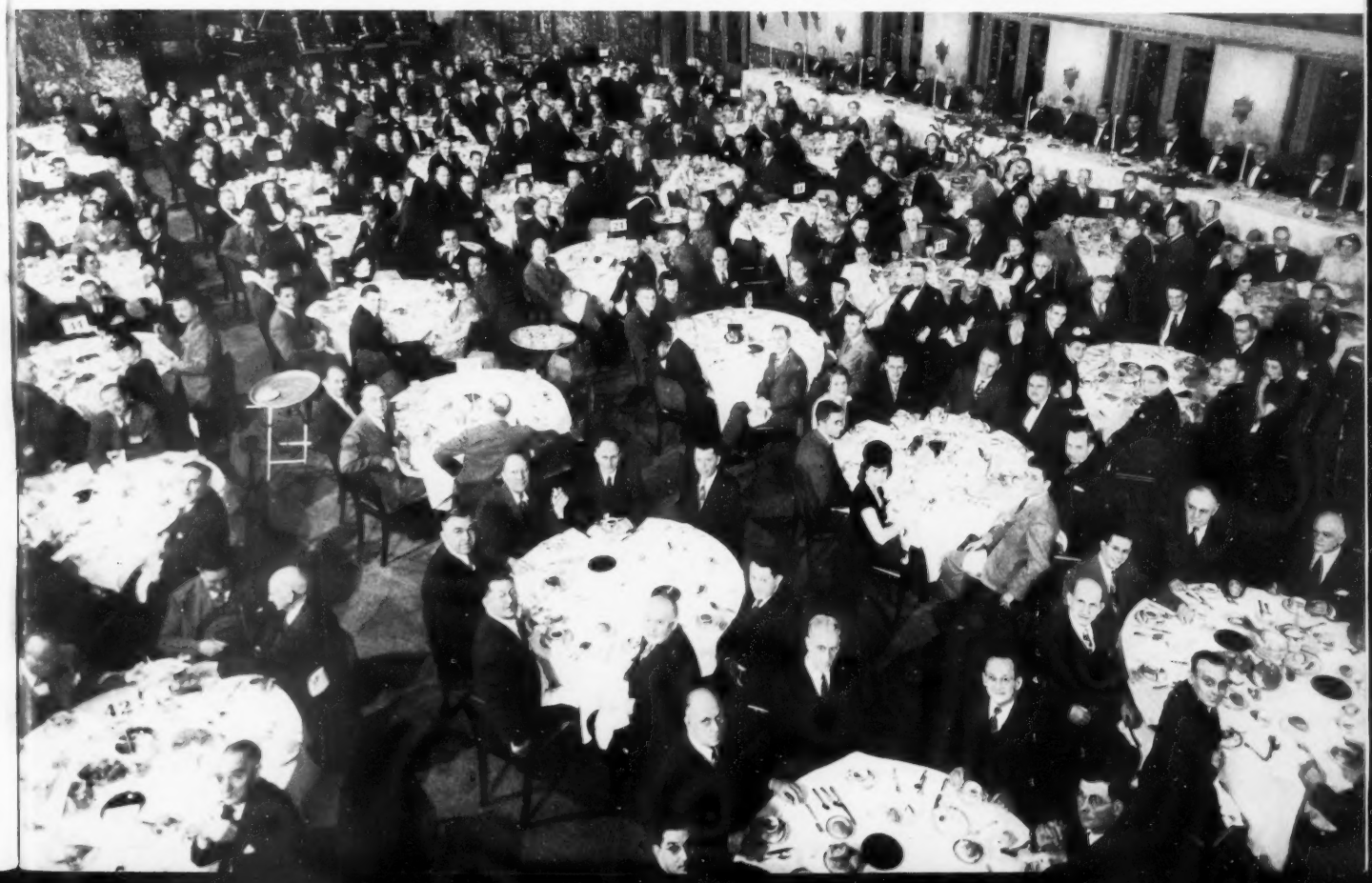
Ex-officio members of the Committee include: G. A. Austin, President of the Association, J. B. Terbell, Chairman of the Manufacturers' Division, and S. P. Moore, Chairman of the Agricultural Limestone Division.

In addition, James Savage was re-elected Treasurer; A. T. Goldbeck, Engineering Director; J. E. Gray, Field Engineer; and J. R. Boyd, Administrative Director and Secretary.

**J. B. Terbell Becomes Chairman of the Manufacturers' Division**

With approximately one hundred members of the Division present at its annual business meeting held

**THE TWENTY-NINTH ANNUAL BANQUET, CINCINNATI, OHIO, JANUARY 30, 1946**



**Manufacturers' Division Breakfast, Cincinnati, Ohio, January 29, 1946**

on Tuesday morning, January 29, 1946, J. B. Terbell of the American Manganese Steel Division, The American Brake Shoe Co., New York City, was elected Chairman of the Division. Also, the following were elected as Vice Chairmen and members of the Board of Directors:

**Vice Chairmen**

| | |
|---|---|
| COTT FARRELL | L. C. MOSLEY |
| R. C. JOHNSON | C. H. ROBERTS |
| J. CRAIG MCLANAHAN | J. A. TRAINOR |

**Board of Directors**

J. B. Terbell, *Chairman,* American Manganese Steel Division, The American Brake Shoe Co., New York, N. Y.
E. C. Anderson, Kensington Steel Co., Chicago, Ill.
A. E. Conover, Robins Conveyors, Inc., Passaic, N. J.
W. C. Davis, Atlas Powder Co., Wilmington, Del.
Irving Deister, Deister Machine Co., Fort Wayne, Ind.
M. A. Eiben, Northern Blower Co., Cleveland, Ohio
S. S. Ellsworth, Ensign-Bickford Co., Simsbury, Conn.
Cott Farrell, Easton Car & Construction Co., Easton, Pa.
R. F. Feind, Allis-Chalmers Mfg. Co., Milwaukee, Wis.
J. Harper Fulkerson, Cross Engineering Co., Carbondale, Pa.
E. J. Goes, Koehring Co., Milwaukee, Wis.
E. M. Heuston, Bucyrus-Erie Co., South Milwaukee, Wis.
C. S. Huntington, Link-Belt Co., Chicago, Ill.
R. C. Johnson, Simplicity Engineering Co., Durand, Mich.
W. W. King, W. S. Tyler Co., Baltimore, Md.
B. R. Maloney, E. I. Du Pont de Nemours & Co., New York, N. Y.
J. Craig McLanahan, McLanahan & Stone Corp., Hollidaysburg, Pa.
L. C. Mosley, Marion Steam Shovel Co., Marion, Ohio
R. M. Murdock, The Frog, Switch & Mfg. Co., New York, N. Y.
Milo A. Nice, Hercules Powder Co., Wilmington, Del.
F. O. Reedy, Kennedy-Van Saun Mfg. & Eng. Co., New York, N. Y.
C. H. Roberts, Traylor Eng. & Mfg. Co., Allentown, Pa.
Bruce G. Shotton, Hendrick Mfg. Co., Pittsburgh, Pa.
P. C. Tennant, The Texas Co., New York, N. Y.
J. A. Trainor, Taylor-Wharton Iron & Steel Co., High Bridge, N. J.
R. E. Wiley, American Cyanamid & Chemical Corp., New York, N. Y.
Roy Wills, Lima Locomotive Works, Lima, Ohio
W. A. Wirene, General Electric Co., Schenectady, N. Y.

**Director of Exhibits**

L. W. Shugg, General Electric Co., Schenectady, N. Y.

**Safety Awards Made at Annual Banquet**

In accord with the custom of many years standing, a feature of the Annual Banquet, held on Wednesday evening, was the presentation of awards to the winners of the National Crushed Stone Association Safety Contest. As will be recalled, this contest is held each year under the supervision of the U. S. Bureau of Mines and elsewhere in this issue there is reported the details of the competition.

We were privileged to have present at the Annual Banquet, Daniel Harrington, Chief, Health and Safety Branch, U. S. Bureau of Mines, Washington, D. C., who presented the awards individually to those representatives of the winning plants who were present.

We are especially indebted to the General Electric Company for its courtesy in permitting James Stokley of the General Electric Research Laboratory to participate in the program for the Tuesday luncheon sponsored by the Manufacturers' Division. His talk entitled, "Science Remakes Our World," proved of unusual interest.

To the many able speakers who contributed so much of interest and value to the convention program, and to the presiding officers and committee personnel, we gratefully acknowledge our deep appreciation for their efforts in making the convention such an outstanding success.

# First Convention of Agricultural Limestone Division a Huge Success

## S. P. MOORE of Iowa Elected Chairman

THE First Annual Convention of the Agricultural Limestone Division of the National Crushed Stone Association held on January 31 and February 1, 1946 at the Hotel Gibson, Cincinnati, Ohio was acclaimed by those in attendance as a huge success. So far as is known this is the first time that producers of agricultural limestone have had a national conclave where they could become acquainted with each other and discuss their many mutual problems among themselves as well as with representatives of Government. Producers who attended the convention represented agricultural limestone operations from Texas to New York and Minnesota to Florida as well as from Canada, convincing evidence that the industry—no matter where located—is interested in the benefits that accrue through cooperative effort.

### Tom Kelly Talks with Chalk

The convention opened with a delightful Greeting Luncheon and was followed immediately by a most interesting, instructive and amusing talk—"Marks and Remarks on Soil Conservation", by Tom Kelly of the Milwaukee office of the Soil Conservation Service. Mr. Kelly keynoted the convention by dramatically presenting the story of soil erosion and the need for soil conservation if America is to survive. He illustrated his major points by cleverly drawing pictures with chalk as he talked about soil losses and wastage and the steps that must be taken to stop exploitation of our most sacred heritage—the soil.

### Smith Urges Industry Cooperation

Following the reports of the Managing Director and Secretary, the group was privileged to hear from Guy W. Smith who ably took Norris E. Dodd's place on the program. (Mr. Dodd could not attend because of urgent business in Washington.) Mr. Smith expressed it as his hope that the convention be the "first milestone of a permanent organization . . . dedicated to the advancement of the agricultural limestone industry and to the betterment of all agriculture". He stated that both government and the industry has a responsibility to shoulder and a job to do in getting farmers to understand the need and value of lime. Full text of Mr. Smith's address is given elsewhere in this issue.

The discussion of Mr. Smith's speech was led by Howard Doerr who is associated with him in Washington. A number of questions on the purchase order plan and other features of the conservation program were answered by these men and other representatives of the Production and Marketing Administration who were present.

At the close of the Thursday afternoon session Mr. Smith broadcast a 10-minute summary of his convention talk from the studios of Station WLW in Cincinnati.

### Much Calcium Required by Farm Animals

The Friday morning session opened with a highly informative talk by Dr. Herbert R. Bird of the Bureau of Animal Industry, Beltsville, Maryland. Dr. Bird authoritatively discussed the mineral nutrition of poultry and farm animals and aroused the interest of those present when he illustrated the importance of sufficient calcium in the diet of laying hens by stating that the egg shells of the 59 billion eggs produced in United States each year require the equivalent of about 326,000 tons of limestone in their formation.

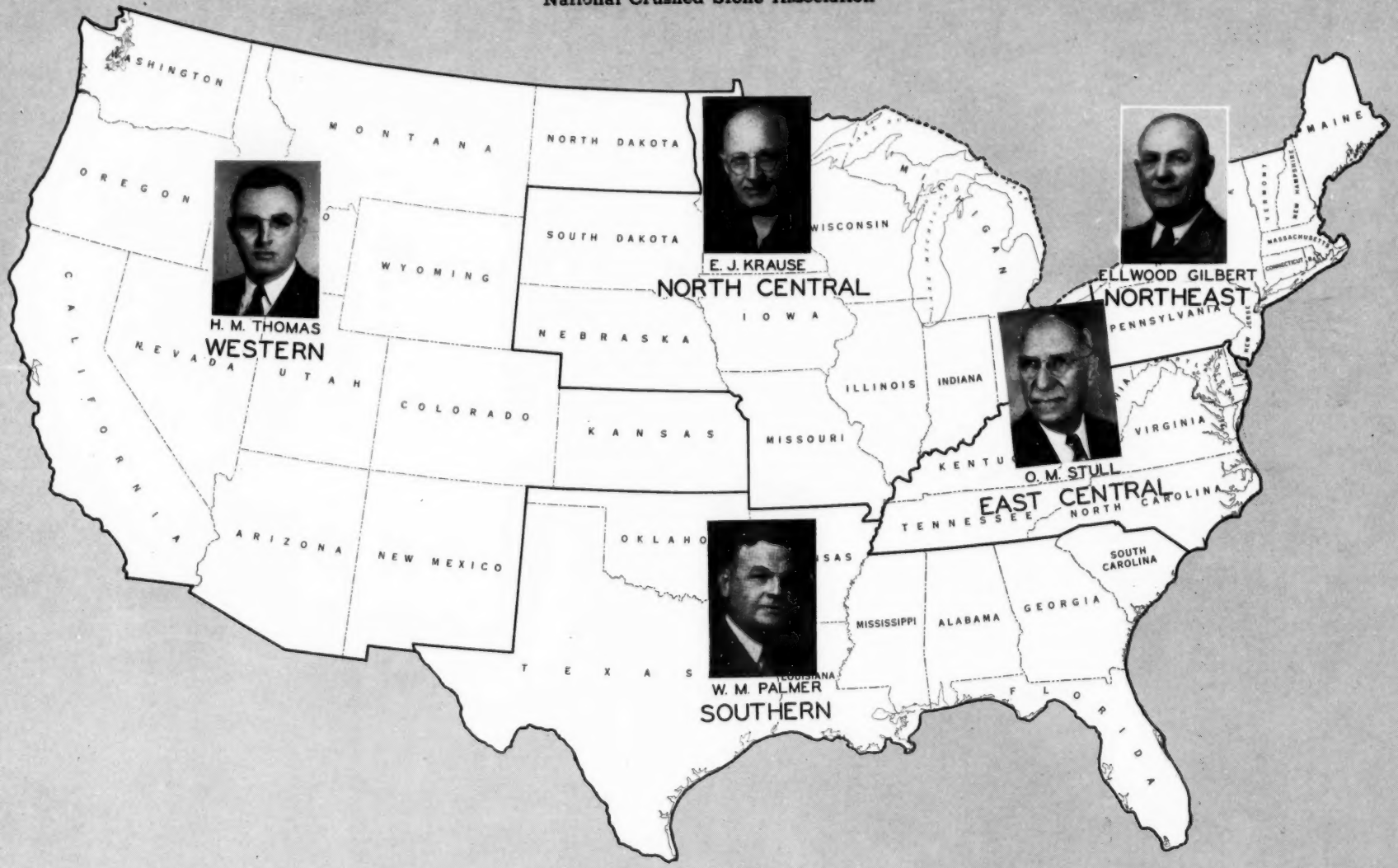
### Lime Maintains Soil's Checking Account

Professor Emil Truog of the University of Wisconsin in his usual masterful manner explained the fundamentals of soil liming and showed by lantern slide illustrations the reasons why soils must be limed. He likened soil fertility to the manner in which man keeps his finances. The plant nutrients that are immediately available are like cash in the pocket; those that are more difficult for the plant to get but not unavailable are like a checking account; and, those that are tightly fixed were placed in the category of money invested in bonds or other securities. He showed how when lime is applied to acid soils it regulates the fertility of the soil by keeping most plant foods in the status of a checking account.

# MAP SHOWING REGIONS AND REGIONAL VICE CHAIRMEN FOR 1946

## AGRICULTURAL LIMESTONE DIVISION

### National Crushed Stone Association



S. P. MOORE, Chairman,
Concrete Materials and Construction Co., Cedar Rapids, Iowa

PAUL I. DETWILER
New Enterprise Stone and Lime Co., New Enterprise, Pa.,
*Northeast Region*

OTHO M. GRAVES
General Crushed Stone Co., Easton, Pa., Representing the National Crushed Stone Association

# EXECUTIVE COMMITTEE

**of the**

**AGRICULTURAL LIMESTONE DIVISION**

**of the National Crushed Stone Association**

**elected by the Board of Directors at its meeting in Cincinnati, Ohio, February 1, 1946**

E. E. HAAPALA
Zumbrota, Minn.,
*North Central Region*

P. E. HEIM
Carbon Limestone Co., Youngstown, Ohio,
*North Central Region*

E. J. KRAUSE
Columbia Quarry Co., St. Louis, Mo.,
*North Central Region*

A. W. MCTHENIA
Acme Limestone Co., Fort Spring, W. Va.,
*East Central Region*

H. M. THOMAS
Fort Scott Hydraulic Cement Co., Fort Scott, Kansas,
*Western Region*

R. T. WILLINGHAM
Willingham-Little Stone Co., Atlanta, Ga., *Southern Region*

## BOARD OF DIRECTORS—AGRICULTURAL LIMESTONE DIVISION

**In addition to the following, the Board of Directors includes members of the Executive Committee and the Regional Vice Chairmen**

★

### NORTHEAST REGION

H. E. Battin, Jr.
Callanan Road Improvement Co., South Bethlehem, N.Y.

H. E. Rainer
Federal Crushed Stone Corp., Buffalo, N.Y.

★

### EAST CENTRAL REGION

Earl L. Dingle
Harry T. Campbell Sons' Corp., Towson, Md.

S. B. Downing, Jr.
Central Rock, Co., Lexington, Ky.

R. P. Immel
American Limestone Co., Knoxville, Tenn.

W. T. Ragland
Superior Stone Co., Raleigh, N. C.

A. B. Rodes
Franklin Limestone Co., Nashville, Tenn.

## NORTH CENTRAL REGION

G. B. CLARK
Midwest Limestone Co., Gilmore City, Iowa

H. A. CLARK
Consumers Co., Chicago, Ill.

W. D. DILLON
Dillon, Sharpe & Co., Centerville, Iowa

JAMES EELLS
Basic Dolomite, Inc., Cleveland, Ohio

A. E. HANSHAW
Lehigh Stone Co., Kankakee, Ill.

A. K. HAUSMANN
Kelley Island Lime and Transport Co., Cleveland, Ohio.

L. W. HAYES
Kansas City, Mo.

W. E. HEWITT
East St. Louis Stone Co., East St. Louis, Ill.

ED. J. LEARY
Ed. J. Leary Construction Co., River Falls, Wis.

S. J. MARKS
Material Service Corporation, Chicago, Ill.

F. W. MUMMA
Columbia Quarry Co., St. Louis, Mo.

PAUL M. NAUMAN
Dubuque Stone Products, Co., Dubuque, Iowa

NORBERT NEUHEISEL
Neuheisel Lime Works, Eau Claire, Wis.

R. M. Seifried
National Lime and Stone, Co., Findlay, Ohio

**SOUTHERN REGION** **WESTERN REGION**

E. V. Scott
Southwest Stone Co.,
Dallas, Texas

C. M. Sims
Campbell Limestone
Co., Gaffney, S. C.

J. J. Stark
Girard, Kansas

### Banking Circles Interested in Liming

J. B. Anderson, Manager of the Bank and Public Relations Department, Federal Reserve Bank of Cleveland, presented an excellent paper on the reasons why bankers are becoming more and more interested in soil building and conservation. There is growing realization that the soil is the basis of wealth in any agricultural community, and that the prosperity of a bank is proportionate to the prosperity of the community it serves. Mr. Anderson stated that the key to improved soil productivity throughout the Fourth Federal Reserve District, is an expanded soil liming program. For that reason the Federal Reserve Bank of Cleveland has taken the lead in encouraging local banks to make long-term loans to farmers for purchasing liming materials.

### Worth Untold Dollars.

One of the members of the Division who attended the convention expressed the thoughts of many when he stated, "So many fine talks and papers were given that the information is worth untold dollars to all of us producers. . . . We thank you for the fine opportunity we had to meet and visit with our fellow producers."

### New Chairmen, Regional Vice Chairmen and Board Members Elected.

At the first annual business meeting of the Division, the Nominating Committee, of which Paul M. Nauman was chairman, submitted the following nominees for Chairman, five Regional Vice Chairmen and twenty-nine Directors, all of whom were unanimously elected.

### BOARD OF DIRECTORS

S. P. Moore, *Chairman,* Concrete Materials and Construction Co., Cedar Rapids, Iowa

#### Northeast Region

Ellwood Gilbert, *Vice Chairman,* New Castle Lime and Stone Co., New Castle, Pa.
H. E. Battin, Jr., Callanan Road Improvement Co., South Bethlehem, N. Y.
Paul I. Detwiler, New Enterprise Stone and Lime Co., New Enterprise, Pa.
H. E. Rainer, Federal Crushed Stone Corp., Buffalo, N. Y.

#### East Central Region

O. M. Stull, *Vice Chairman,* Liberty Limestone Corp., Buchanan, Va.
Earl L. Dingle, Harry T. Campbell Sons' Corp., Towson, Md.
S. B. Downing, Jr., Central Rock Co., Lexington, Ky.
R. P. Immel, American Limestone Co., Knoxville, Tenn.
A. W. McThenia, Acme Limestone Co., Fort Spring, W. Va.
W. T. Ragland, Superior Stone Co., Raleigh, N. C.
A. B. Rodes, Franklin Limestone Co., Nashville, Tenn.

#### North Central Region

E. J. Krause, *Vice Chairman,* Columbia Quarry Co., St. Louis, Mo.
G. B. Clark, Midwest Limestone Co., Gilmore City, Iowa
H. A. Clark, Consumers Co., Chicago, Ill.
W. D. Dillon, Dillon, Sharpe & Co., Centerville, Iowa
James Eells, Basic Dolomite, Inc., Cleveland, Ohio
E. E. Haapala, Zumbrota, Minn.
A. E. Hanshaw, Lehigh Stone Co., Kankakee, Ill.
A. K. Hausmann, Kelley Island Lime and Transport Co., Cleveland, Ohio

L. W. Hayes, Kansas City, Missouri
P. E. Heim, Carbon Limestone Co., Youngstown, Ohio
W. E. Hewitt, East St. Louis Stone Co., East St. Louis, Ill.
Ed. J. Leary, Ed. J. Leary Construction Co., River Falls, Wis.
S. J. Marks, Material Service Corporation, Chicago, Ill.
F. W. Mumma, Columbia Quarry Co., St. Louis, Mo.
Paul M. Nauman, Dubuque Stone Products Co., Dubuque, Iowa
Norbert Neuheisel, Neuheisel Lime Works, Eau Claire, Wis.
R. M. Seifried, National Lime and Stone Co., Findlay, Ohio

**Southern Region**

W. M. Palmer, *Vice Chairman,* Dolomite Products, Inc., Ocala, Fla.
E. V. Scott, Southwest Stone Co., Dallas, Texas
C. M. Sims, Campbell Limestone Co., Gaffney, S. C.
R. T. Willingham, Willingham-Little Stone Co., Atlanta, Ga.

**Western Region**

H. M. Thomas, *Vice Chairman,* Fort Scott Hydraulic Cement Co., Fort Scott, Kansas
J. J. Stark, Girard, Kansas

**Representing the N. C. S. A.**

Otho M. Graves, General Crushed Stone, Easton, Pa.

S. P. Moore of the Concrete Materials and Construction Co., Cedar Rapids, Iowa made a most constructive statement in accepting the Chairmanship of the Division for this year. He stressed the importance of the agricultural limestone industry working as a unit through its trade association in furthering the interests of all concerned and said that he considered the relationship of the Agricultural Limestone Division to the National Crushed Stone Association, not as child to parent, but as junior partner.

### New Board Elects Executive Committee and N. C. S. A. Board Representatives

Late Friday afternoon at the first meeting of the newly elected Board of Directors the following were elected to the Executive Committee for the ensuing year:

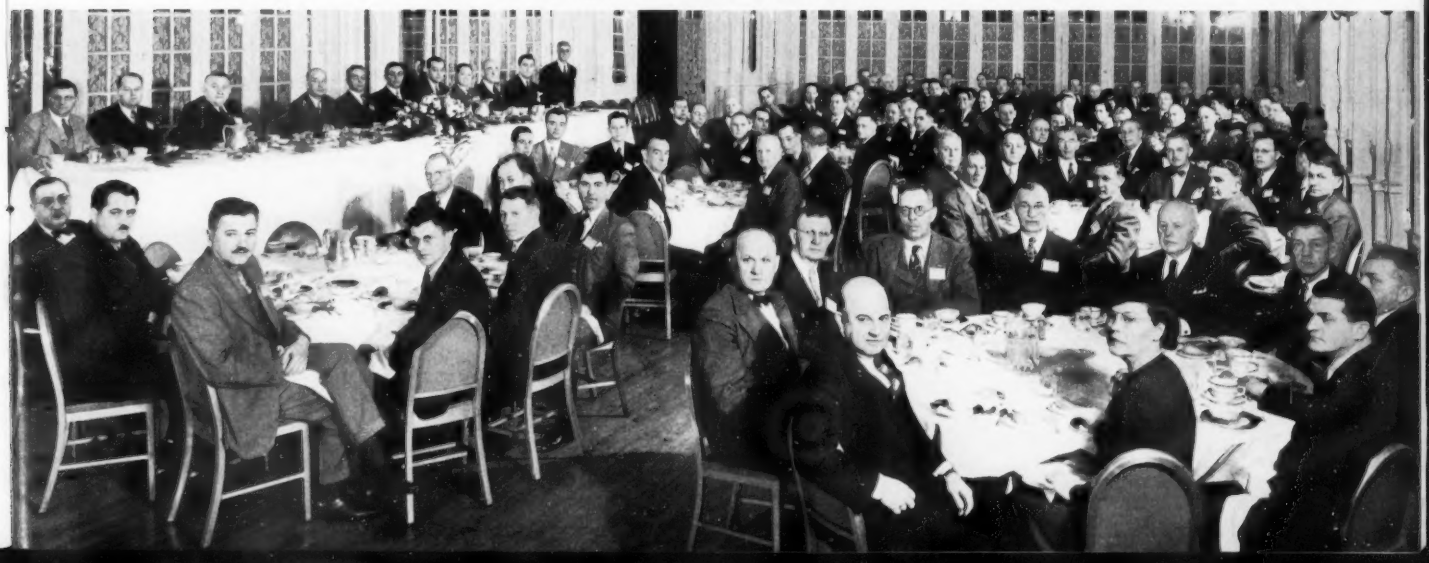
| | |
|---|---|
| PAUL I. DETWILER | E. J. KRAUSE |
| E. E. HAAPALA | A. W. MCTHENIA |
| P. E. HEIM | H. M. THOMAS |

R. T. WILLINGHAM

The Executive Committee also includes as ex-officio members thereof, S. P. Moore, Chairman of the Division, and Otho M. Graves, representing the National Crushed Stone Association.

Also, as permitted by the By-laws, the Board elected E. E. Haapala and James Eells to serve with S. P. Moore, Chairman of the Division, as its representatives on the Board of Directors of the National Crushed Stone Association. Otho M. Graves was previously elected by the NCSA Board to represent it on the Board of Directors of the Division. J. R. Boyd was re-elected Secretary-Treasurer and Henry A. Huschke, Managing Director.

**GREETING LUNCHEON—FIRST ANNUAL CONVENTION AGRICULTURAL LIMESTONE DIVISION CINCINNATI, OHIO, JANUARY 31, 1946**



# Postwar Construction Outlook[1]

**By H. E. FOREMAN**

**Managing Director, The Associated General Contractors of America Washington, D. C.**

PRESIDENT EARNSHAW, members and guests of the National Crushed Stone Association.

Because of the common interests which you men and general contractors have, I am glad of this opportunity to be here with you. Our associations have worked closely in the past in striving for common objectives, and I am sure that that cooperation will continue.

There has been assigned me a difficult subject to speak on: Postwar Construction Outlook. I wish that I, or anyone else, could predict accurately what will happen in construction in the next few years.

It is certain, however, that many of the actions taken in the reconversion program during 1946 will have a strong influence upon the future economic life of the nation.

During the year the construction industry faces what is probably the greatest demand for its services that it has ever known. But if prolonged strikes or other difficulties should shut off adequate quantities of basic construction materials or equipment for a substantial portion of the year, the slump in construction would help to plunge the nation into a bitter depression.

This, it seems to me, is a time to be neither unduly optimistic or pessimistic, but to look at the facts squarely.

It is now less than six months after shooting stopped in the greatest war in history of the world. The upheavals in this country and throughout the world were greater than ever before. It is no easy task to pass immediately from the unprecedented problems of war to the equally tremendous problems of peace, and expect that the transition will be made smoothly.

The construction industry during the war provided the physical facilities necessary to train, equip, supply, transport and prepare our armed forces for attack. This work was the foundation of the war effort. It had to precede most other parts of the war effort. Had this industry failed, the entire war effort would have been hampered, perhaps disastrously.

But the construction industry completed its work on or ahead of schedule. And this nation's ability to construct was the one capacity which our enemies throughout the war consistently underestimated. This industry, in this country and overseas as a part of the armed forces, had such a tremendous capacity for accomplishment that our enemies never were able to understand how we could do so much so fast.

It is certainly reasonable to assume that an industry with such a wartime record is going to accomplish its peacetime tasks with equal drive.

### Construction Volume

A significant fact about the 1946 construction volume is that it will not be limited by lack of market or demand. The needs and demands of all types of construction will be greater during the year than can be supplied immediately. The principal limiting factors will be shortages of materials and labor.

Various estimates have been made of the amount of construction to be undertaken during 1946, based upon the assumption of increased production of materials. The Department of Commerce has estimated a total volume of $12,500,000,000, composed of $7,500,000,000 for new construction, and $5,000,000,000 for maintenance and repair. The amount for new construction was composed of $5,350,000,000 for privately financed construction, and $2,150,000,000 for public works.

Highway expenditures for 1946 are estimated at from $700,000,000 to $800,000,000. The Federal Works Agency, which was less optimistic in its 1946 estimates than the Department of Commerce, estimated highway activity during the year at $700,000,000. The Engineering News Record, after a survey of state highway departments, estimate expenditures approaching $800,000,000 on federal and state-aid highways in 1946.

Estimates from highway departments indicated that about 15,000 miles of new grading and draining is contemplated, and the amount of pavement of all

[1] Presented at the 29th Annual Convention, National Crushed Stone Association, Netherland Plaza Hotel, Cincinnati, Ohio, January 28-30, 1946.

kinds proposed to be laid during the year exceeds 18,000 miles.

The fact that federal aid airport legislation has not yet been agreed upon by conferees of the House and Senate leaves unpredictable the amount of airport construction during the year. It can be expected, however, that the airport program will be slow in developing even after the legislation is passed, because surveys and plans have to be made, local matching funds arranged for, and other preliminaries completed before construction can start.

All estimates of construction for 1946 agree that privately financed construction—housing, industrial, and commercial—will be two to three times the amount of public works.

I think it is significant that the A. G. C. Market Development Committee, which during the war devoted its energies to stimulating the advance planning of postwar construction projects, last November recommended that general contractors counsel with purchasers of construction, architects, engineers, public officials and others in their own communities to secure by local determination the release of new construction work in such a manner that most vital construction needs are served first and the investor secures maximum value for his investment in construction.

The fact is that even if more construction were completed this year than ever before in any one year, the demand still would be far from unsatisfied. So it will be a duty of the industry to help secure the release of work in such a manner that most urgent needs are satisfied first.

### 1946 Highway Program

Whether the 1946 highway program is 700 or 800 million dollars, it will be a substantial increase over the amount estimated for 1945, which was $280,000,000. Fortunately, the end of the war has found no field of construction better prepared with finances and plans than highways.

In 1941, $10,000,000 in federal funds was authorized for plans and surveys. In 1943 an additional $50,000,000 was authorized for the purpose. In 1944 the $3,000,000,000 postwar highway construction program was authorized. Last fall the war emergency was declared terminated for purposes of highway construction, and on December 28 the first appropriation was made for the postwar program. That legislation was consistently supported by the A. G. C.

While preparations are being made for a large volume of highway construction to get under way this year, the subject of costs and prices becomes increasingly important.

Major General Philip B. Fleming, Administrator, Federal Works Agency, in a statement issued this month has pointed out that due to uncertainties as to future costs and other factors, construction bids being received by government agencies are frequently running far above estimates. He then states:

"Governments must make a major decision. If they accept high bids in the expectation of permanently higher prices, the result will be an increase in costs without a corresponding increase in work accomplished. Tax increases will be unavoidable. What the effects may be on the long-time profits of contractors is questionable. If contract prices rise, costs will rise. In the end contractors under a competitive system may be making little more than before prices rose. Yet they will be paying higher prices, and so will the taxpayers.

"If, on the other hand, governments take the view that present trends in bids are more a result of uncertainties than of inescapable cost increases, they will award contracts only for work which must proceed even at high cost; they will be doing their part to help labor and industry bring an end to current uncertainties. When contractors can bid on the basis of known costs, taxpayers can again get their money's worth, and contractors can feel assured that a large volume of work will be awarded—work needed to meet the huge backlog that developed in the public field during the war.

"Governments are asking consumers to buy cautiously to avoid forcing prices up; governments themselves must exercise the same restraint."

I can agree in part with General Fleming, but I would like to correct some inferences which he makes. I can agree that government should defer its construction which is not urgently needed when it competes with privately financed construction, and when it must be secured at greater costs than will become normal.

But I should like to correct the inference he has made that contractors have an interest in higher costs than are necessary. It has been my experience that contractors are continuously trying to devise means of executing work more efficiently so that it can be done for a lower cost.

During these times when the availability of labor and the future wage rate are uncertain, and when the prices and delivery dates of many materials are also uncertain, construction costs are bound to be higher than in more stable periods. While contrac-

tors in their business must take risks, they must be calculated risks. No one is benefited when a contractor takes such an unreasonable risk that he goes out of business.

Uncertainties of when materials will be delivered, and uncertainties of the availability of labor make it necessary for contractors to protect themselves against what could be disastrous losses.

When conditions become more easily predictable in the future, the bids of contractors may be lower than they are now. But there can be no return to prewar prices. There is a nation-wide trend in every industry for higher wages. This means higher material prices and higher labor costs. What the percentage increases over prewar prices will be when conditions settle down no one knows.

So long as there is a trend encouraged by the Federal Government for wage increases in all industry, I feel that it is safe to predict that there will be no substantial general reduction in highway construction costs during the year.

**Day Labor Construction**

The extent to which current construction costs will be used as arguments for various governmental units to undertake construction with their own forces cannot be accurately forecast now.

It is known, however, that efforts have been made by county officials to secure federal-aid funds for secondary roads directly from the Federal Government rather than through state highway departments. And pressure has been brought to bear for the Federal Government to sell at reduced prices, or to give away free, to state and local government surplus construction equipment.

These efforts are in the direction of enabling various governmental agencies to perform their construction operations with their own forces. This is naturally of direct concern to general contractors because it deprives them of legitimate markets for their services.

But it has been demonstrated conclusively time and time again that regular private construction firms can execute the construction more efficiently, more economically, more quickly, and of higher quality than can governmental units trying to do the work with their own forces. For that reason our association consistently opposes day labor operations.

And I may say to you, that the greater is the tendency for day labor in construction operations, the greater is the tendency for governmental units to supply their own aggregates.

**Conclusion**

During 1946 the construction industry is faced with a demand for its services which cannot be quickly satisfied with a rate of productivity exceeding any previously accomplished.

We in the industry must exert every effort to accomplish as much as possible to fulfill the needs of the public, and must give our best advice so that most urgent needs are cared for first.

The industry can get a good start on what could be one of the greatest construction programs the nation ever had, performing the work which will be necessary if the nation is to grow and prosper the way every one hopes. Estimates have been made that within a few years the annual volume of construction should be in the neighborhood of $20,000,000,000 under conditions of a high level of productivity.

Or the industry this year could be thrown into a slump which would plunge the nation into a depression if prolonged strikes should deny the industry the materials and equipment it needs.

This year is for construction, as for all other phases of our national life and economy, a crucial period when decisions made now will exert their influence over a long period in the future.

All of us in the industry during the year must exert our efforts to help bring about a constant improvement in our standards of living in the country through private enterprise. The prosperity of the industry and the nation depends on this.

All of us must work closely with governmental agencies so that laws and policies are adopted which allow the industry to operate most effectively.

Because bickering between management and labor will not lead to high production and employment, we must cooperate with labor in our industry.

We must strive to hold our prices in line, and to constantly improve our operations so that the public receives continuously greater value for its investment in construction.

And I believe that we must continue to give more attention in the operations of our business to the opinions of the public. Ultimately, the volume of work which this industry performs in the future will depend to a great extent upon the confidence which others have in us.

When I consider the war accomplishments of the construction industry, I cannot help but feel that it will tackle its peacetime job with the same determination and drive and with the same outstanding results.

# Agricultural Limestone and Its Place in A.A.A.'s Postwar Program[1]

By GUY W. SMITH

Director, North Central Region
Field Service Branch, Production
and Marketing Administration
U. S. Department of Agriculture,
Washington, D. C.

I am very happy to attend this first annual convention of the Agricultural Limestone Division of the National Crushed Stone Association. It is my hope that this meeting is the first milestone of a permanent organization which will be dedicated to the advancement of the agricultural limestone industry and to the betterment of all agriculture. We, in Government, have felt the need for a long time of some type of organization where the mutual problems of the industry, Government, and agriculture could be discussed. You can be assured that we intend to avail ourselves of the services which this organization can offer and we invite you to consult with us at any time concerning problems of mutual interest. Basically, the problems of the limestone industry are the problems of agriculture . . . our objectives are identical and the success in obtaining these objectives will be determined to a large extent by the manner in which we all pull together for the ultimate good of the industry . . . the farmer . . . and agriculture in general.

In accordance with the mandate of Congress, we representatives of the Government are charged with the responsibility of providing the mechanics for the performance of all soil-building practices. One of the most critically needed practices and one for which we earmark a large percentage of our time and assistance to farmers is the application of agricultural limestone. We facilitate and encourage the use of lime in several ways. First, we offer a conservation payment for the application of the material. This payment varies between States and averages between 70 and 80 percent of the cost of the lime delivered to the farm. For farmers who are unable to purchase their entire requirements directly from the limestone vendor, we offer further assistance by way of Government contracts and purchase orders. I will not dwell on the contract method since all of you are familiar with that phase of the program. The Purchase Order Plan is comparatively new and is in operation in several States this year. Under this plan the farmer makes his own arrangements with the vendor for delivery of the lime. A fair price is determined for each transaction. The fair price so determined is the price agreed to between the farmer and the vendor on one hand and the farmer and the county committee on the other hand. If the county committee approves the price quoted the farmer by the vendor, the farmer is issued a purchase order by the county committee which he surrenders to the vendor at the time of delivery. The farmer pays the vendor in cash the difference between the fair price and the applicable practice credit rate. The vendor looks to the Government for payment of the balance due on a purchase order.

In our opinion, the Purchase Order Plan is a step in the furtherance of our policy of distributing all materials through established local dealer channels and making it possible for the farmer and the vendor to conduct their business with as little interference from the Government as possible. Under the Purchase Order Plan, the responsibility for obtaining a source of supply . . . the determination of price . . . and obtaining delivery is placed on the farmer and the vendor. As we have stated in the past . . . we have no desire to be in the limestone business . . . we will be most happy when the day arrives when the farmer and the vendor can conduct their entire negotiations without the assistance of Government purchases. Until that day arrives we stand ready to either contract for or issue purchase orders for the amount necessary to assure maximum pro-

1 Presented at the First Annual Convention of the Agricultural Limestone Division, N.C.S.A., Gibson Hotel, Cincinnati, Ohio, January 31 and February 1, 1946.

duction of limestone. We are most desirous of extending the Purchase Order Plan as the various State Committees and vendors within the States feel that the situation warrants such action. We are also willing to forego both contracts and purchase orders in areas where we can be assured that the lime program will continue and increase.

I will not attempt to explain in detail the need for lime . . . others who will appear on this program later are more qualified for this job . . . however, I would like to point out that each of us has a responsibility to shoulder and a job to do . . . you gentlemen of the limestone industry have a great responsibility . . . and we in Government must share that responsibility with you. You . . . the producers and distributors of agricultural limestone . . . are challenged by this and all future generations with a sound, economically feasible program for supplying the nation with a basic ingredient needed to maintain the fertility of the soil. When you stop and realize that all civilization is dependent on the fertility of a bit of top soil approximately four inches in depth around the world . . . it is self-evident that the performance of your industry will share a heavy part of the destiny of future civilization.

It is important that farmers understand the need and value of lime . . . we are carrying on this campaign continually . . . but we cannot do it alone . . . it is imperative that you also join us in spreading the word . . . it is important that every man connected with the industry . . . whether he is an executive, foreman, laborer, or trucker be apprised of the reasons for applying lime. Many a trucker or other worker knows only that he is handling ground rock . . . he has not the slightest conception of the why or wherefor of agricultural limestone . . . it is our hope that you will take whatever action necessary to inform all of your employees of the reasons why we must use lime and of the benefits which accrue to all people by virtue of fertile soils. Make every man connected with the industry an active advocate of the use of lime . . . every man in our organization intends to preach the story of lime and if every man in your organization is equipped to do likewise, we will have established the basic foundation necessary to guarantee the maintenance of soil fertility.

The late President Roosevelt once said, "The history of every nation is eventually written in the way in which it cares for the soil." So gentlemen, let's work together to care for the soil in such a manner that the future health and well-being of all Americans will reflect the results of the fertile soils of this nation for centuries to come.

This year we have inaugurated a new approach to our Agricultural Conservation Program in most of the States. I would like to take a little time right here to tell you about this new approach and explain how we think your industry can best fit into such a program. During past programs the funds appropriated by the Congress for Agricultural Conservation were broken down to individual farms by use of a so-called farm allowance. This allowance was determined on the basis of the number of acres of cropland in the farm and without regard to the amount of soil conservation needed. This type of program presented many inequities . . . in some cases, the farm allowance would not permit the performance of nearly enough of the types of soil conservation needed on the farm . . . in other cases farms had an allowance which was not in keeping with the actual amount of conservation needs. Under our new plan, the allowance method has been thrown out the window . . . the conservation needs of each farm will be considered on the basis of the current needs for soil conservation on that particular farm. Even though our old type of program did present many inequities, we must not lose sight of the fact that past programs have contributed greatly to increased conservation of the nation's soils. It is a matter of record that the soils of thousands of farms have been restored to a state of high fertility and that the need and value of soil conservation has been demonstrated to millions of farmers. This new approach to the conservation problem will permit the continuance of all established and proven conservation practices and will also provide more latitude for the judgment of the community and county committeemen in obtaining additional conservation on those farms where the need is most urgent.

In each county the county and community committeemen have met and selected from all the practices approved for the State, the practices most critically needed in their county. The practices so selected are the only practices which will be approved for payment in the county during 1946. For the farmer to earn a payment, each practice must have the prior approval of the county committee. Each county is given a definite amount of money to use in obtaining performance of these selected practices. The community committeemen are going down the road right now to visit each farmer and assist him in planning his 1946 conservation program. The

amount of funds available for each farm will be limited only by the amount of conservation needed on the farm after consideration of the needs of all farms and the amount of the over-all county budget. It is possible under this plan for a farmer whose allowance in past years would only permit the approval of five tons of lime to receive 25 or 50 tons of lime if that practice was the most critically needed practice on his farm. By the same token, if a particular farm has been completely limed or, in the opinion of the community committeemen and the farmer, other practices are more urgently needed, it is possible that no lime will be approved for payment on this farm. Another example would be a case where a large drainage ditch on one farm would benefit other farms. It is possible, under this program, to provide one farm with sufficient assistance to build the drainage ditch and provide no funds this year for the other farms which would benefit from this drainage project.

Briefly, the success of the program rests on the judgment of the community committeemen and the farmer as to what are the most critically needed practices on each farm and the amount of assistance necessary to get the job done.

If you gentlemen are wondering as to how this type of program will affect the use of lime, let me assure you that there will be a market for all the material which you will be able to produce. As an example, I would like to cite what happened to my own county which is Lucas County, Iowa. I attended the meeting there last December at which the thirty-six community committeemen in my county and the county committee met to select the practices to be approved for payment in Lucas County during 1946. By a unanimous vote the application of limestone was selected as the number one practice for 1946 and it was the consensus of opinion that it would continue to be the number one practice in Lucas County for years to come. Now my county needs many types of conservation practices, including contouring, fertilizer, and the plowing under of green manure crops, and many other practices. I believe the decision of these farmers is representative of the thinking of all well informed farmers in the areas of acid soils. These men realize that the basis of all soil fertility is lime and if they are to administer a sound conservation program it is imperative they do the first things first. It would be of little value to contour or terrace in an effort to hold the fertility of the soil unless you first do the things which would create a fertile soil.

Now here is how I think your industry can be most helpful in this program . . . remember first that all practices which qualify for payment must have the prior approval of the county committee. Before long each county will have determined the extent and kind of practices for each farm . . . these determinations will include millions of tons of lime. We think it worthwhile for you or your local representative to visit each county office . . . consult with the county committee concerning the volume of lime for which approval is intended . . . work out a plan with each county committee for delivery of the tonnage approved. The farmer will earn credit regardless of whether the material is purchased for cash or through AAA contracts or purchase orders. Remember . . . these approvals represent the considered judgment of the community and county committees and the farmers as to where lime is most critically needed. Give the county committee some idea as to the volume which can be expected in the county . . . make every effort to deliver lime first to those farmers who have prior approval . . . their lime orders are the only ones in the county which will receive conservation payments and these farmers are the ones who need lime first. Since we do not have enough lime to go around, let's put what we do have where it will do the most good. I can assure you that every county committee is ready and anxious to work with you in planning the limestone phase of their program. It will be of little value and will cause many disappointments if a county committee approves 50,000 tons of lime when your industry can only furnish 20,000 tons of lime in the county. Let's not end another year with a lot of unfilled promises . . . let's work it out ahead of time and make commitments which we are reasonably sure of being able to fill . . . and let's try our best to meet those commitments . . . a farmer who waits two years or longer for a promised order of lime soon ceases to be a friend of the program or a friend of your industry.

I think it worthwhile that we take just a few minutes to review where we have been and contemplate on where we are going. I would first like to call your attention to the chart shown on the screen. This chart tells the story of your industry since 1929 . . . it also tells the story of the farmer's income over the same period. The growth of your industry has been amazing during the past 10 years. But, gentlemen, you have only scratched the surface . . . you still have better than two customers for each ton of lime. Twenty-three million tons of lime is a

far cry from the 1½ million tons of lime distributed in 1933 . . . however, 23 million tons isn't much more than a maintenance job . . . we will continue to lose soil fertility until we can get at least 51 million tons of lime annually.

Let's look at the chart for a minute . . . prior to 1933 the consumption of lime and farm income traveled in the same direction . . . mostly downward. After 1933, farm income started upward but lime deliveries didn't pick up until 1936. 1936 was the first year AAA offered a conservation payment for the application of lime. It is interesting to note that the consumption of lime in 1936 was almost double the 1935 consumption. During the years 1936 to 1940 farm income stayed fairly constant . . . in fact, it decreased slightly but the consumption of lime showed a steady increase . . . this increase, no doubt, can be attributed to Government assistance by way of AAA payments. Then in 1939 the AAA started

ANNUAL LIMING MATERIAL CONSUMPTION

to contract for the delivery of lime. I think it significant that while farm income between 1939 and 1940 increased only slightly . . . the consumption of lime increased from 9 million tons in 1939 to 14 million tons in 1940 . . . and since 1940 the use of lime has increased tremendously each year except during the critical war year of 1943. However, after considering all the obstacles which confronted your industry in 1943, we still think you did a marvelous job.

There appears to be no doubt that AAA payments and AAA purchases contributed to the increased use of lime . . . but we must not lose sight of the influence of farm income on the consumption of lime. Today, and in the years to come the cost of lime and the farmers' income must bear an economically sound relationship. Each year the amount of lime being purchased for cash is increasing . . . each year the amount purchased by AAA is decreasing . . . even on AAA purchases the farmer must contribute part of the cost in cash. This all adds up to one thing . . . if your industry is to eventually reach the place where your business with the farmer can be conducted without Government assistance and the use of lime is to reach desirable levels, the cost of lime to the farmer must remain in its proper relationship to the farmer's income. We are not extortionists nor are we advocates of price cutting . . . we acknowledge that you are entitled to a fair profit for your efforts . . . we insist that you receive a fair profit because we know that it is necessary for the welfare of the nation that you continue in business and continue to expand your operations to more than twice present production. But, gentlemen, for your good and the nation's good, please do not let the old law of supply and demand cause you to peg prices at a point which will discourage the farmer from purchasing lime in the quantities he actually needs.

We are on the threshold of a new era in business and in agriculture. The emphasis will be more and more on encouraging private enterprise and the rebuilding, expanding, and replenishing of the industrial and agricultural resources of the nation. Your industry has a running start in this new era of accomplishments . . . throughout the war years, you mastered many of the obstacles which would have discouraged a less aggressive industry . . . your accomplishments during those years were all the more remarkable because, generally speaking, you were a young industry.

One of the first big steps in the agricultural postwar era is to convert millions of acres of cropland to grassland. This huge acreage was converted at the request of the War Food Administration to the production of additional quantities of soybeans, hemp, and other vital food and fibre crops to facilitate the war effort. The critical need for this additional acreage of war crops will disappear. The type of crops grown on this land has exhausted the major portion of the fertility which existed at the time when it was converted . . . these acres converted to grass will play a very important part in our postwar economy. The level of income for all workers is higher than ever before. The nation is a meat eating nation . . . more people than ever will want to eat more and more beef, pork, lamb, and other animal products. Millions of acres of additional

(*Continued on Page 37*)

# The National Crushed Stone Association Safety Competition of 1944

By J. I. DAVIS
R. W. ARTHUR

**Under supervision of Forrest T. Moyer, Chief, Accident Analysis Division, Economics and Statistics Branch, U. S. Bureau of Mines.**

THE FREQUENCY and severity rates of injuries at the crushed stone operations enrolled in the 1944 Safety Competition were slightly lower than in 1943. A total of 36 operations—32 quarries and 4 underground mines—were entered in the 19th annual accident-prevention contest conducted by the Bureau of Mines, United States Department of the Interior in cooperation with the National Crushed Stone Association. These plants were worked 4,723,929 man-hours during 1944 with an injury-frequency rate of 32.6 per million man-hours and an injury-severity rate of 7.1 per thousand man-hours of exposure to plant hazards. Of the 36 operations, 11 had no lost-time accidents during the year.

The Marquette limestone quarry of the Marquette Cement Manufacturing Company at Cape Girardeau, Missouri had the best safety record in 1944, and the bronze plaque provided by the *Explosives Engineer* magazine was awarded to this operation. Employees worked 84,374 man-hours throughout the year without a disabling accident. The Marquette quarry has been enrolled each year since the Competition started, and of these 19 years, 14 were free of accidents. During its participation, the quarry has won the trophy 4 times and has received honorable mention 10 times.

Ten plants received honorable mention for operating throughout the year with accident-free records and were awarded parchment reproductions of the quarry scene on the bronze plaque. Each employee of a plant that has an accident-free record is presented with a Certificate of Honor for his part in preventing accidents. The 10 plants are as follows:

Martinsburg limestone quarry, North American Cement Corporation, Martinsburg, Berkeley County, West Virginia; 82,370 man-hours.

White Haven sandstone quarry, General Crushed Stone Company, White Haven, Luzerne County, Pennsylvania; 62,922 man-hours.

Union Furnace limestone quarry, Warner Company, Tyrone, Huntingdon County, Pennsylvania; 55,319 man-hours.

Security limestone quarry, North American Cement Corporation, Hagerstown, Washington County, Maryland; 48,716 man-hours.

No. 4 trap-rock quarry, Southwest Stone Company, Knippa, Uvalde County, Texas; 43,698 man-hours.

Jordanville limestone quarry, General Crushed Stone Company, Jordanville, Herkimer County, New York; 43,047 man-hours.

Dunbar limestone mine, New Castle Lime and Stone Company, Dunbar, Fayette County, Pennsylvania; 42,578 man-hours.

Catskill limestone quarry, North American Cement Corporation, Catskill, Greene County, New York; 33,760 man-hours.

Winchester trap-rock quarry, General Crushed Stone Company, Winchester, Middlesex County, Massachusetts; 19,703 man-hours.

Middlefield No. 1 quarry, New Haven Trap Rock Company, Wallingford, New Haven County, Connecticut; 14,943 man-hours.

The following 15 States were represented in the 1944 contest:

| State | No. of plants | State | No. of plants | State | No. of plants |
|---|---|---|---|---|---|
| California | 1 | Massachusetts | 1 | Pennsylvania | 10 |
| Connecticut | 4 | Michigan | 1 | South Carolina | 1 |
| Illinois | 2 | Missouri | 2 | Texas | 2 |
| Iowa | 1 | New York | 6 | Virginia | 2 |
| Maryland | 1 | Oklahoma | 1 | West Virginia | 1 |

All 36 plants enrolled in 1944 were also enrolled in 1943. Four of these plants had accident-free records in both years; 17 had better severity rates in 1944; and 15 had worse severity rates in 1944. The following is a comparison of these identical plants:

| Year | Man-hours worked | Total number of injuries | Total number of days of disability | Frequency rate | Severity rate |
|---|---|---|---|---|---|
| 1943 | 5,558,950 | 185 | 40,937 | 33.280 | 7.364 |
| 1944 | 4,723,929 | 154 | 33,519 | 32.600 | 7.096 |

| Year | Number of injuries | | | | | Number of days of disability | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | F. | P.T. | P.P. | Temp. | Total | F. | P.T. | P.P. | Temp. | Total |
| 1943 | 4 | — | 8 | 173 | 185 | 24,000 | — | 12,096 | 4,841 | 40,937 |
| 1944 | 4 | — | 5 | 154 | 154 | 24,000 | — | 5,400 | 4,119 | 33,519 |

Sixty-three percent of the accidents, for which causes were given, resulted from falls of persons, handling materials or objects, haulage, and hand tools. These same causes accounted for 40 percent of the days of disability.

Tables 1 and 2 show the relative standing of the open quarries and underground mines, arranged in ascending order of accident-severity rates of the plants. When two or more plants have accident-free records, the number of man-hours governs the order.

TABLE 1

RELATIVE STANDING OF QUARRIES IN THE 1944 NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, BASED UPON THE ACCIDENT-SEVERITY RATES OF THE QUARRIES.[1]

| Rank of plant | Man-hours worked | Number of injuries [2] | | | | | Average days of disability per temp. injury | Number of days of disability [2] | | | | | Frequency rate[3] | Severity rate[3] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | F. | P.T. | P.P. | Temp. | Total | | F. | P.T. | P.P. | Temp. | Total | | |
| 1 | 84,374 | — | — | — | — | — | — | — | — | — | — | — | 0.000 | 0.000 |
| 2 | 82,370 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 3 | 62,922 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 4 | 55,319 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 5 | 48,716 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 6 | 43,698 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 7 | 43,047 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 9 | 33,760 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 10 | 19,703 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 11 | 14,943 | — | — | — | — | — | — | — | — | — | — | — | .000 | .000 |
| 12 | 103,020 | — | — | — | 1 | 1 | 3 | — | — | — | 3 | 3 | 9.707 | .029 |
| 13 | 94,304 | — | — | — | 1 | 1 | 7 | — | — | — | 7 | 7 | 10.604 | .074 |
| 14 | 198,947 | — | — | — | 4 | 4 | 19 | — | — | — | 76 | 76 | 20.106 | .382 |
| 15 | 71,250 | — | — | — | 3 | 3 | 11 | — | — | — | 33 | 33 | 42.105 | .463 |
| 16 | 178,799 | — | — | — | 7 | 7 | 14 | — | — | — | 100 | 100 | 39.150 | .559 |
| 17 | 130,844 | — | — | — | 4 | 4 | 19 | — | — | — | 76 | 76 | 30.571 | .581 |
| 18 | 195,010 | — | — | — | 15 | 15 | 10 | — | — | — | 149 | 149 | 76.919 | .764 |
| 19 | 41,571 | — | — | — | 1 | 1 | 37 | — | — | — | 37 | 37 | 24.055 | .890 |
| 21 | 65,631 | — | — | — | 2 | 2 | 35 | — | — | — | 69 | 69 | 30.473 | 1.051 |
| 22 | 426,735 | — | — | — | 11 | 11 | 43 | — | — | — | 476 | 476 | 25.777 | 1.115 |
| 23 | 180,911 | — | — | — | 9 | 9 | 23 | — | — | — | 209 | 209 | 49.748 | 1.155 |
| 24 | 128,796 | — | — | — | 8 | 8 | 19 | — | — | — | 151 | 151 | 62.114 | 1.172 |
| 25 | 225,394 | — | — | — | 21 | 21 | 13 | — | — | — | 278 | 278 | 93.170 | 1.233 |
| 26 | 126,290 | — | — | — | 5 | 5 | 32 | — | — | — | 158 | 158 | 39.591 | 1.251 |
| 27 | 685,740 | — | — | 2 | 8 | 10 | 93 | — | — | 600 | 740 | 1,340 | 14.583 | 1.954 |
| 28 | 325,953 | — | — | 1 | 2 | 3 | 26 | — | — | 600 | 51 | 651 | 9.204 | 1.997 |
| 29 | 104,408 | — | — | — | 2 | 2 | 106 | — | — | — | 211 | 211 | 19.156 | 2.021 |
| 31 | 28,317 | — | — | — | 1 | 1 | 300 | — | — | — | 300 | 300 | 35.314 | 10.594 |
| 33 | 28,005 | — | — | 1 | — | 1 | — | — | — | 1,800 | — | 1,800 | 35.708 | 64.274 |
| 34 | 79,170 | 1 | — | — | 7 | 8 | 13 | 6,000 | — | — | 93 | 6,093 | 101.048 | 76.961 |
| 35 | 46,241 | 1 | — | — | 6 | 7 | 18 | 6,000 | — | — | 106 | 6,106 | 151.381 | 132.047 |
| 36 | 42,245 | 1 | — | — | — | 1 | — | 6,000 | — | — | — | 6,000 | 23.671 | 142.029 |
| Totals and rates 1944 | 3,996,433 | 3 | — | 4 | 118 | 125 | 28 | 18,000 | — | 3,000 | 3,323 | 24,323 | 31.278 | 6.086 |
| Totals and rates 1943 | 4,750,314 | 4 | — | 5 | 134 | 143 | 29 | 24,000 | — | 7,146 | 3,862 | 35,008 | 30.103 | 7.370 |

[1] As reports from mining companies are considered confidential by the Bureau of Mines, the identities of the plants to which this table relates are not revealed.

[2] F., fatal; P.T., permanent total disability; P.P. permanent partial disability; Temp., temporary disability.

[3] Frequency rate indicates the number of fatal, permanent, and other disabling injuries per million man-hours of exposure; severity rate indicates number of days of disability lost from injuries per thousand man-hours of exposure.

TABLE 2

RELATIVE STANDING OF UNDERGROUND MINES IN THE 1944 NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, BASED UPON THE ACCIDENT-SEVERITY RATES OF THE MINES[1]

| Rank of plant | Man-hours worked | Number of injuries[1] | | | | | Average days of disability per temp. injury | Number of days of disability[1] | | | | | Frequency rate[1] | Severity rate[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | F. | P.T. | P.P. | Temp. | Total | | F. | P.T. | P.P. | Temp. | Total | | |
| 8 | 42,578 | — | — | — | — | — | — | — | — | — | — | — | 0.000 | 0.000 |
| 20 | 128,765 | — | — | — | 5 | 5 | 27 | — | — | — | 134 | 134 | 38.830 | 1.041 |
| 30 | 288,750 | — | — | 1 | 4 | 5 | 43 | — | — | 2,400 | 171 | 2,571 | 17.316 | 8.904 |
| 32 | 267,403 | 1 | — | — | 18 | 19 | 27 | 6,000 | — | — | 491 | 6,491 | 71.054 | 24.274 |
| Totals and rates, 1944 | 727,496 | 1 | — | 1 | 27 | 29 | 29 | 6,000 | — | 2,400 | 796 | 9,196 | 39.863 | 12.641 |
| Totals and rates, 1943 | 1,019,771 | — | — | 3 | 45 | 48 | 25 | — | — | 4,950 | 1,123 | 6,073 | 47.069 | 5.955 |

[1] See footnotes 1, 2, and 3, Table 1.

TABLE 3

YEARLY SUMMARY—QUARRIES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1926-44[1]

| Year | Plants | Man-hours worked | Number of injuries[1] | | | | | Number of days of disability[1] | | | | | Frequency rate[1] | Severity rate[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fatal | P.T. | P.P. | Temp. | Total | Fatal | P.T. | P.P | Temp. | Total | | |
| 1925[2] | 38 | 4,927,402 | 4 | —— | 3 | 292 | 299 | 24,000 | —— | 3,600 | 5,286 | 32,886 | 60.681 | 6.674 |
| 1926 | 40 | 5,298,983 | 3 | —— | 6 | 207 | 216 | 18,000 | —— | 9,000 | 4,239 | 31,239 | 40.763 | 5.895 |
| 1927 | 48 | 7,876,791 | 9 | —— | 2 | 458 | 469 | 54,000 | —— | 2,100 | 7,186 | 63,286 | 59.542 | 8.034 |
| 1928 | 53 | 7,509,098 | 8 | —— | 4 | 322 | 334 | 48,000 | —— | 8,700 | 5,493 | 62,193 | 44.479 | 8.282 |
| 1929 | 53 | 7,970,325 | 4 | —— | 5 | 286 | 295 | 24,000 | —— | 5,760 | 5,533 | 35,293 | 37.012 | 4.428 |
| 1930 | 68 | 8,013,415 | 6 | —— | 9 | 227 | 242 | 36,000 | —— | 7,250 | 3,671 | 46,921 | 30.199 | 5.855 |
| 1931 | 58 | 5,085,857 | 4 | —— | 13 | 198 | 215 | 24,000 | —— | 18,660 | 3,540 | 46,200 | 42.274 | 9.084 |
| 1932 | 40 | 2,661,850 | 1 | —— | 4 | 75 | 80 | 6,000 | —— | 6,750 | 2,481 | 15,231 | 30.054 | 5.722 |
| 1933 | 40 | 2,704,871 | 1 | —— | 1 | 67 | 69 | 6,000 | —— | 48 | 2,893 | 8,941 | 25.510 | 3.306 |
| 1934 | 46 | 3,288,257 | 1 | —— | 2 | 106 | 109 | 6,000 | —— | 2,850 | 1,873 | 10,723 | 33.148 | 3.261 |
| 1935 | 46 | 4,166,306 | 2 | 1 | 8 | 77 | 88 | 12,000 | 6,000 | 9,900 | 3,015 | 30,915 | 21.122 | 7.420 |
| 1936 | 50 | 6,399,023 | 5 | —— | 14 | 182 | 201 | 30,000 | —— | 8,168 | 4,590 | 42,758 | 31.411 | 6.682 |
| 1937 | 47 | 6,199,001 | 7 | —— | 9 | 136 | 152 | 42,000 | —— | 5,875 | 4,461 | 52,336 | 24.520 | 8.443 |
| 1938 | 47 | 4,658,119 | 2 | —— | 6 | 76 | 84 | 12,000 | —— | 6,600 | 3,184 | 21,784 | 18.033 | 4.677 |
| 1939 | 44 | 4,219,086 | 2 | —— | 2 | 51 | 55 | 12,000 | —— | 4,800 | 1,678 | 18,478 | 13.036 | 4.380 |
| 1940 | 46 | 4,358,409 | 1 | —— | 5 | 78 | 84 | 6,000 | —— | 2,550 | 3,013 | 11,563 | 19.273 | 2.653 |
| 1941 | 47 | 5,777,587 | 3 | —— | 5 | 98 | 106 | 18,000 | —— | 9,300 | 2,266 | 29,566 | 18.347 | 5.117 |
| 1942 | 48 | 7,178,935 | 3 | 2 | 1 | 183 | 189 | 18,000 | 12,000 | 1,500 | 4,239 | 35,739 | 26.327 | 4.978 |
| 1943 | 34 | 4,750,314 | 4 | —— | 5 | 134 | 143 | 24,000 | —— | 7,146 | 3,862 | 35,008 | 30.103 | 7.370 |
| 1944 | 32 | 3,996,433 | 3 | —— | 4 | 118 | 125 | 18,000 | —— | 3,000 | 3,323 | 24,323 | 31.278 | 6.086 |
| Total 1926-44 | — | 102,112,660 | 69 | 3 | 105 | 3,079 | 3,256 | 414,000 | 18,000 | 119,957 | 70,540 | 622,497 | 31.886 | 6.096 |
| Total 1925-44 | — | 107,040,062 | 73 | 3 | 108 | 3,371 | 3,555 | 438,000 | 18,000 | 123,557 | 75,826 | 655,383 | 33.212 | 6.123 |

[1] See footnotes 1, 2, and 3, Table 1.

[2] The National Crushed Stone Association Safety Competition began in 1926; figures for 1925 for company members are given for comparison.

TABLE 4

YEARLY SUMMARY—UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1926-44[1]

| Year | Plants | Man-hours worked | Number of injuries[1] | | | | | Number of days of disability[1] | | | | | Frequency rate[1] | Severity rate[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fatal | P.T. | P.P. | Temp. | Total | Fatal | P.T. | P.P | Temp. | Total | | |
| 1925[2] | 3 | 400,672 | — | — | — | 29 | 29 | —— | —— | —— | 228 | 228 | 72.378 | 0.569 |
| 1926 | 3 | 517,926 | — | — | — | 34 | 34 | —— | —— | —— | 533 | 533 | 65.646 | 1.029 |
| 1927 | 2 | 318,449 | 1 | — | 1 | 14 | 16 | 6,000 | —— | 300 | 68 | 6,368 | 50.244 | 19.997 |
| 1928 | 5 | 542,193 | 1 | — | 1 | 68 | 70 | 6,000 | —— | 300 | 888 | 7,188 | 129.105 | 13.257 |
| 1929 | 4 | 665,520 | 1 | — | 1 | 30 | 32 | 6,000 | —— | 300 | 617 | 6,917 | 48.083 | 10.393 |
| 1930 | 6 | 595,367 | 1 | — | 1 | 15 | 17 | 6,000 | —— | 225 | 468 | 6,693 | 28.554 | 11.242 |
| 1931 | 3 | 345,105 | — | — | — | 4 | 4 | —— | —— | —— | 147 | 147 | 11.591 | .426 |
| 1932 | 2 | 158,450 | — | — | — | 6 | 6 | —— | —— | —— | 165 | 165 | 37.867 | 1.041 |
| 1933 | 3 | 229,381 | — | — | — | 11 | 11 | —— | —— | —— | 349 | 349 | 47.955 | 1.521 |
| 1934 | 4 | 248,146 | — | — | — | 13 | 13 | —— | —— | —— | 287 | 287 | 52.389 | 1.157 |
| 1935 | 2 | 175,994 | — | — | — | 3 | 3 | —— | —— | —— | 249 | 249 | 17.046 | 1.415 |
| 1936 | 4 | 334,747 | 1 | — | — | 7 | 8 | 6,000 | —— | —— | 117 | 6,117 | 23.899 | 18.274 |
| 1937 | 3 | 364,680 | — | — | — | 3 | 3 | —— | —— | —— | 91 | 91 | 8.226 | .250 |
| 1938 | 3 | 334,442 | — | — | — | 2 | 2 | —— | —— | —— | 133 | 133 | 5.980 | .398 |
| 1939 | 4 | 393,039 | — | — | 1 | 7 | 8 | —— | —— | 600 | 457 | 1,057 | 20.354 | 2.689 |
| 1940 | 4 | 375,987 | — | — | 1 | 8 | 9 | —— | —— | 4,500 | 888 | 5,388 | 23.737 | 14.330 |
| 1941 | 4 | 591,568 | — | — | 1 | 15 | 16 | —— | —— | 750 | 169 | 919 | 27.047 | 1.553 |
| 1942 | 4 | 785,894 | — | — | 1 | 33 | 34 | —— | —— | 1,800 | 1,213 | 3,013 | 43.263 | 3.834 |
| 1943 | 5 | 1,019,771 | — | — | 3 | 45 | 48 | —— | —— | 4,950 | 1,123 | 6,073 | 47.069 | 5.955 |
| 1944 | 4 | 727,496 | 1 | — | 1 | 27 | 29 | 6,000 | —— | 2,400 | 796 | 9,196 | 39.863 | 12.641 |
| Total 1926-44 | — | 8,724,155 | 6 | — | 12 | 345 | 363 | 36,000 | —— | 16,125 | 8,758 | 60,883 | 41.609 | 6.979 |
| Total 1925-44 | — | 9,124,827 | 6 | — | 12 | 374 | 392 | 36,000 | —— | 16,125 | 8,986 | 61,111 | 42.960 | 6.697 |

[1] See footnotes 1, 2, and 3, Table 1.

[2] The National Crushed Stone Association Safety Competition began in 1926; figures for 1925 for company members are given for comparison.

TABLE 5

YEARLY SUMMARY—QUARRIES AND UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION, 1926-44[1]

| Year | Plants | Man-hours worked | Number of injuries[1] | | | | | Number of days of disability[1] | | | | | Frequency rate[1] | Severity rate[1] |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Fatal | P.T. | P.P. | Temp. | Total | Fatal | P.T. | P.P | Temp. | Total | | |
| 1925[2] | 41 | 5,328,074 | 4 | —— | 3 | 321 | 328 | 24,000 | —— | 3,600 | 5,514 | 33,114 | 61.561 | 6.215 |
| 1926 | 43 | 5,816,909 | 3 | —— | 6 | 241 | 250 | 18,000 | —— | 9,000 | 4,772 | 31,772 | 42.978 | 5.462 |
| 1927 | 50 | 8,195,240 | 10 | —— | 3 | 472 | 485 | 60,000 | —— | 2,400 | 7,254 | 69,654 | 59.181 | 8.499 |
| 1928 | 58 | 8,051,291 | 9 | —— | 5 | 390 | 404 | 54,000 | —— | 9,000 | 6,381 | 69,381 | 50.178 | 8.617 |
| 1929 | 57 | 8,635,845 | 5 | —— | 6 | 316 | 327 | 30,000 | —— | 6,060 | 6,150 | 42,210 | 37.865 | 4.888 |
| 1930 | 74 | 8,608,782 | 7 | —— | 10 | 242 | 259 | 42,000 | —— | 7,475 | 4,139 | 53,614 | 30.086 | 6.228 |
| 1931 | 61 | 5,430,962 | 4 | —— | 13 | 202 | 219 | 24,000 | —— | 18,660 | 3,687 | 46,347 | 40.324 | 8.534 |
| 1932 | 42 | 2,820,300 | 1 | —— | 4 | 81 | 86 | 6,000 | —— | 6,750 | 2,646 | 15,396 | 30.493 | 5.459 |
| 1933 | 43 | 2,934,252 | 1 | —— | 1 | 78 | 80 | 6,000 | —— | 48 | 3,242 | 9,290 | 27.264 | 3.166 |
| 1934 | 50 | 3,536,403 | 1 | —— | 2 | 119 | 122 | 6,000 | —— | 2,850 | 2,160 | 11,010 | 34.498 | 3.113 |
| 1935 | 48 | 4,342,300 | 2 | 1 | 8 | 80 | 91 | 12,000 | 6,000 | 9,900 | 3,264 | 31,164 | 20.957 | 7.177 |
| 1936 | 54 | 6,733,770 | 6 | —— | 14 | 189 | 209 | 36,000 | —— | 8,168 | 4,707 | 48,875 | 31.038 | 7.258 |
| 1937 | 50 | 6,563,681 | 7 | —— | 9 | 139 | 155 | 42,000 | —— | 5,875 | 4,552 | 52,427 | 23.615 | 7.987 |
| 1938 | 50 | 4,992,561 | 2 | —— | 6 | 78 | 86 | 12,000 | —— | 6,600 | 3,317 | 21,917 | 17.226 | 4.390 |
| 1939 | 48 | 4,612,125 | 2 | —— | 3 | 58 | 63 | 12,000 | —— | 5,400 | 2,135 | 19,535 | 13.660 | 4.236 |
| 1940 | 50 | 4,734,396 | 1 | —— | 6 | 86 | 93 | 6,000 | —— | 7,050 | 3,901 | 16,951 | 19.643 | 3.580 |
| 1941 | 51 | 6,369,155 | 3 | —— | 6 | 113 | 122 | 18,000 | —— | 10,050 | 2,435 | 30,485 | 19.155 | 4.786 |
| 1942 | 52 | 7,964,829 | 3 | 2 | 2 | 216 | 223 | 18,000 | 12,000 | 3,300 | 5,452 | 38,752 | 27.998 | 4.865 |
| 1943 | 39 | 5,770,085 | 4 | —— | 8 | 179 | 191 | 24,000 | —— | 12,096 | 4,985 | 41,081 | 33.102 | 7.120 |
| 1944 | 36 | 4,723,929 | 4 | —— | 5 | 145 | 154 | 24,000 | —— | 5,400 | 4,119 | 33,519 | 32.600 | 7.096 |
| Total 1926-44 | — | 110,836,815 | 75 | 3 | 117 | 3,424 | 3,619 | 450,000 | 18,000 | 136,082 | 79,298 | 683,380 | 32.652 | 6.166 |
| Total 1925-44 | — | 116,164,889 | 79 | 3 | 120 | 3,745 | 3,947 | 474,000 | 18,000 | 139,682 | 84,812 | 716,494 | 33.978 | 6.168 |

[1] See footnotes 1, 2, and 3, Table 1.

[2] The National Crushed Stone Association Safety Competition began in 1926; figures for 1925 for company members are given for comparison.

Tables 3 and 4 show yearly summary figures from 1926 to 1944, and for Association members for 1925, the year before the contests were organized. Table 5 shows a yearly combined summary of open quarries and underground mines in the Competition. The number of injuries by causes and the days of disability by causes of injuries are shown in tables 6 and 7. Table 8 gives the average days of disability for temporary injuries at mines and quarries enrolled in the contest.

TABLE 6

NUMBER OF INJURIES, BY CAUSES, AT QUARRIES AND UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION IN 1944.

| Cause | Fatal | Permanent Total | Permanent Partial | Tempo-rary | Total |
|---|---|---|---|---|---|
| Falls and slides of rock | — | — | — | 1 | 1 |
| Handling materials or objects | — | — | — | 27 | 27 |
| Hand tools | — | — | 2 | 15 | 17 |
| Explosives | — | — | — | — | — |
| Haulage | 1 | — | 1 | 17 | 19 |
| Falls of persons | — | — | 1 | 26 | 27 |
| Bumping against objects | — | — | — | 3 | 3 |
| Falling objects | — | — | — | 11 | 11 |
| Flying objects or particles | — | — | — | 3 | 3 |
| Electricity | 1 | — | — | 3 | 4 |
| Drilling | 1 | — | — | 9 | 10 |
| Machinery | 1 | — | 1 | 9 | 11 |
| Stepping on objects | — | — | — | — | — |
| Burns | — | — | — | 8 | 8 |
| Other causes | — | — | — | 1 | 1 |
| Total | 4 | — | 5 | 133 | 142 |
| Not stated | — | — | — | 12 | 12 |
| Grand total | 4 | — | 5 | 145 | 154 |

TABLE 7

DAYS OF DISABILITY BY CAUSES OF INJURIES AT QUARRIES AND UNDERGROUND MINES IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION IN 1944.

| Cause | Fatal | Permanent Total | Permanent Partial | Tempo-rary | Total |
|---|---|---|---|---|---|
| Falls and slides of rock | — | — | — | 8 | 8 |
| Handling materials or objects | — | — | — | 584 | 584 |
| Hand tools | — | — | 2,400 | 234 | 2,634 |
| Explosives | — | — | — | — | — |
| Haulage | 6,000 | — | 300 | 742 | 7,042 |
| Falls of persons | — | — | 2,400 | 764 | 3,164 |
| Bumping against objects | — | — | — | 113 | 113 |
| Falling objects | — | — | — | 294 | 294 |
| Flying objects or particles | — | — | — | 63 | 63 |
| Electricity | 6,000 | — | — | 55 | 6,055 |
| Drilling | 6,000 | — | — | 202 | 6,202 |
| Machinery | 6,000 | — | 300 | 611 | 6,911 |
| Stepping on objects | — | — | — | — | — |
| Burns | — | — | — | 149 | 149 |
| Other causes | — | — | — | 10 | 10 |
| Total | 24,000 | — | 5,400 | 3,829 | 33,229 |
| Not stated | — | — | — | 290 | 290 |
| Grand total | 24,000 | — | 5,400 | 4,119 | 33,519 |

TABLE 8

AVERAGE DAYS OF DISABILITY PER TEMPORARY INJURY AT PLANTS ENROLLED IN THE NATIONAL CRUSHED STONE ASSOCIATION SAFETY COMPETITION

| Year | Underground mines | | | Open quarries | | | Total | | |
|---|---|---|---|---|---|---|---|---|---|
| | No. of temporary injuries | No. of days of disability | Average days of disability | No. of temporary injuries | No. of days of disability | Average days of disability | No. of temporary injuries | No. of days of disability | Average days of disability |
| 1925 | 29 | 228 | 8 | 292 | 5,286 | 18 | 321 | 5,514 | 17 |
| 1926 | 34 | 533 | 16 | 207 | 4,239 | 20 | 241 | 4,772 | 20 |
| 1927 | 14 | 68 | 5 | 458 | 7,186 | 16 | 472 | 7,254 | 15 |
| 1928 | 68 | 888 | 13 | 322 | 5,493 | 17 | 390 | 6,381 | 16 |
| 1929 | 30 | 617 | 21 | 286 | 5,533 | 19 | 316 | 6,150 | 19 |
| 1930 | 15 | 468 | 31 | 227 | 3,671 | 16 | 242 | 4,139 | 17 |
| 1931 | 4 | 147 | 37 | 198 | 3,540 | 18 | 202 | 3,687 | 18 |
| 1932 | 6 | 165 | 28 | 75 | 2,481 | 33 | 81 | 2,646 | 33 |
| 1933 | 11 | 349 | 32 | 67 | 2,893 | 43 | 78 | 3,242 | 42 |
| 1934 | 13 | 287 | 22 | 106 | 1,873 | 18 | 119 | 2,160 | 18 |
| 1935 | 3 | 249 | 83 | 77 | 3,015 | 39 | 80 | 3,264 | 41 |
| 1936 | 7 | 117 | 17 | 182 | 4,590 | 25 | 189 | 4,707 | 25 |
| 1937 | 3 | 91 | 30 | 136 | 4,461 | 33 | 139 | 4,552 | 33 |
| 1938 | 2 | 133 | 67 | 76 | 3,184 | 42 | 78 | 3,317 | 43 |
| 1939 | 7 | 457 | 65 | 51 | 1,678 | 33 | 58 | 2,135 | 37 |
| 1940 | 8 | 888 | 111 | 78 | 3,013 | 39 | 86 | 3,901 | 45 |
| 1941 | 15 | 169 | 11 | 98 | 2,266 | 23 | 113 | 2,435 | 22 |
| 1942 | 33 | 1,213 | 37 | 183 | 4,239 | 23 | 216 | 5,452 | 25 |
| 1943 | 45 | 1,123 | 25 | 134 | 3,862 | 29 | 179 | 4,985 | 28 |
| 1944 | 27 | 796 | 29 | 118 | 3,323 | 28 | 145 | 4,119 | 28 |
| Total | 374 | 8,986 | 24 | 3,371 | 75,826 | 22 | 3,745 | 84,812 | 23 |

# The Effect of Air-Entrainment on the Durability of Concrete Pavement in Ohio[1]

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I WAS quite pleased that when Mr. Goldbeck suggested a subject for this paper he included the word "Durability," for it has always seemed to me that too many of the material producers and engineers associated with highway construction are interested primarily in production and in concrete strength and that durability is given much less consideration than it rightly deserves. What does strength avail us if the concrete produced is not durable? Numerous papers have been presented at conventions such as this on the use of air-entrainment in concrete. I intend to confine my remarks solely to the experiences which we have had here in Ohio with air-entrained concrete, particularly with the effect of the entrained air on the durability of the resultant concrete.

Our first field experience with air-entrainment in concrete was in 1940, when we built our Test Road. A report of this Test Road is given in the Proceedings of the Twenty-Second Annual Meeting of the Highway Research Board. The principal features of the various test sections on this project were the cements and combinations of different cements manufactured with and without air-entraining agents. Both portland and natural cements were used, both types of which were manufactured with and without air-entraining agents.

Numerous cores were taken from each of the sections and tested by freezing and thawing. The cores were drilled from the pavement at ages of 15 days to 2 months and stored in air until placed in test at the age of 7 to 10 months. The portion of the cores tested by freezing and thawing consisted of the top 2 to 4 inches of each core. These were soaked in water for 4 days and then frozen in a 10% calcium chloride solution at approximately —35°F.

Figure 1 illustrates graphically the loss in weight of the concrete due to air-entrainment and the resistance to freezing and thawing. The plotted points were determined by interpolation, using the average weight loss at each 25-cycle weighing period for all cores tested containing the same cement or cements, regardless of the method of finishing. All points were considered in drawing the curve. However, since it is empirical, it should not be extended beyond the actual test results.

As may be seen, the results of these tests indicate a marked resistance to the destructive action of freezing and thawing for concrete having a loss in unit weight in excess of 2 pounds per cubic foot, regardless of the air-entraining agent used.

It has been our practice to make periodic inspections on this project, generally once a year. The last inspection was made in November of 1945. At that time none of the sections represented on the graph which were made from concrete having a loss in weight in excess of 2½ lbs. per cubic foot were scaled, while some sections having a loss in weight less than 2½ lbs. per cubic foot were scaled, some much more than others. I should like to make clear, however, that some of these latter sections were free from scale. The study of these data indicates that the minimum loss in weight of air-entrained concrete when compared to non-air-entrained concrete should be at least three pounds. In order that we may have a sufficient safety factor against scaling, assuming ½ to 1% air in non-air-entrained concrete, a minimum of 3% air would have to be specified in any future concrete placed, in order that proper protection could be assured.

The use of air-entrained concrete does result in somewhat lower flexural and compressive strength, and for this reason the wisdom of its widespread use has been questioned in some quarters.

The pavement on this project was placed directly on plastic A-4 and A-7 silty clay soils, the A-7 soils predominating. These soils afford very poor support to pavement slabs and most of the pumping which has developed on our pavements in the past few years has been on soils of these types. On these soils in more recent years, subgrades have been strengthened by the use of granular subbases, 9 to

[1] Presented at the 29th Annual Convention, National Crushed Stone Association, Netherland Plaza Hotel, Cincinnati, Ohio, January 28-30, 1946.

18 inches thick. The Test Road is located on U. S. Route 40, the National Highway, just west of Columbus and carries about 6,000 vehicles daily.

Referring again to the Test Road, sections made with an average loss in unit weight in excess of 6

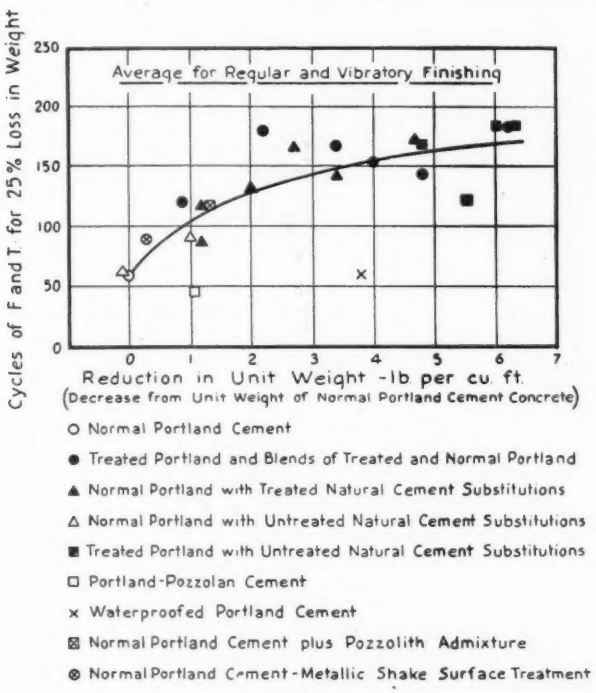
Cycles of F and T. for 25% Loss in Weight
250
200
150
100
50
0
Average for Regular and Vibratory Finishing
0 1 2 3 4 5 6 7
Reduction in Unit Weight -lb per cu. ft.
(Decrease from Unit Weight of Normal Portland Cement Concrete)
○ Normal Portland Cement
● Treated Portland and Blends of Treated and Normal Portland
▲ Normal Portland with Treated Natural Cement Substitutions
△ Normal Portland with Untreated Natural Cement Substitutions
■ Treated Portland with Untreated Natural Cement Substitutions
□ Portland-Pozzolan Cement
× Waterproofed Portland Cement
⊠ Normal Portland Cement plus Pozzolith Admixture
⊗ Normal Portland Cement-Metallic Shake Surface Treatment

FIGURE 1
RELATION BETWEEN REDUCTION IN UNIT WEIGHT OF CONCRETE AND RESISTANCE TO F. AND T. OF TOPS OF CORES.
*Tests by Research Laboratory of the Portland Cement Association.*

pounds, most certainly have an air content of at least 5%. In all probability some of the concrete in such sections has in excess of 6% air. I would like to emphasize that although these sections had air-entrainment amounting to as high as 5 or 6%, although the beam test results indicated a decrease in percent of strength as high as 20% or more, and although the subgrade is relatively poor, there are no structural failures on this project after 5½ years' service under comparatively heavy truck and passenger traffic.

During the spring of 1941 our Laboratory started an investigation with the primary intent of determining the relative effectiveness of various treatments which could be applied to concrete pavements for protection against the damage attributed to chemical ice removal agents, such as calcium chloride and sodium chloride. Cements containing vinsol resin and beef tallow as air-entraining agents were also included in the investigation.

Panels or blocks, each 10″x10″x3″, were made of concrete containing 6 sacks of cement per cubic yard, using 1½″ top size coarse aggregate. Natural sand was used as the fine aggregate and gravel as the coarse aggregate. The aggregates selected were borderline cases as far as the quality requirements of our Specifications were concerned, both having a relatively high soundness loss and some chert and shale particles. However, both of the aggregates, fine and coarse, did meet the Specifications under which our concrete pavements are built. These blocks were given a broom finish when cast. The day after casting, each block was removed from its mold and a raised mortar lip, triangular in section, 1″ thick at the base, and 1″ high, was cast onto the outside edge of the block. The lips were designed to retain water or chloride solution on the surface

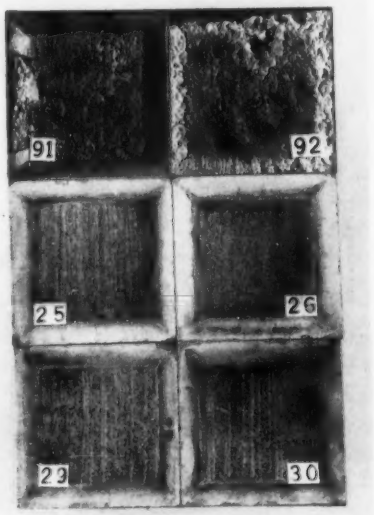


FIGURE 2
RESISTANCE TO NATURAL FREEZING AND THAWING.
*Nos. 91 & 92 Normal Portland Cement Concrete*
*Nos. 25 & 26 Similar Concrete With .05% Vinsol Resin Interground With Cement*
*Nos. 29 & 30 Similar Concrete With .05% Beef Tallow Interground With Cement*

of each block. All of the blocks were cured in the moist room until at least 28 days old.

The blocks were tested as follows:

The blocks were covered with one-half pint of water (approximately 0.2 of an inch deep) and

placed in the cold storage room. The temperature of this cold storage room ranged from —8° F. to —28° F. with an average temperature of —15° F. The following morning the blocks were removed from cold storage and those to be thawed with calcium or sodium chloride were covered with a solution of such strength that one-half pint of solution contained the same quantity of chloride as would have been applied had the dry salt been used at the rate of 2 pounds per square yard. The blocks which were thawed naturally were merely permitted to thaw at room temperature.

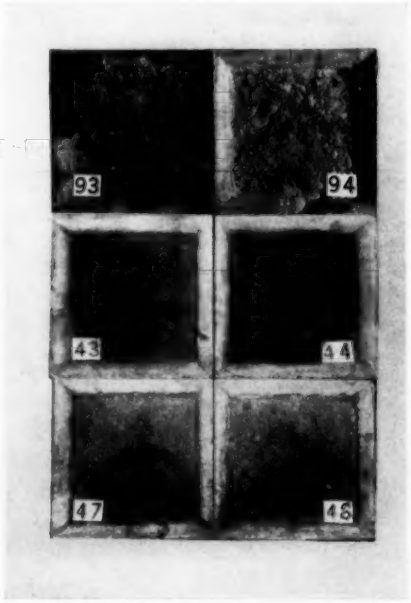


FIGURE 3

RESISTANCE TO NATURAL FREEZING AND THAWING WITH CALCIUM CHLORIDE (2 POUNDS PER SQUARE YARD).

*Nos. 93 & 94 Normal Portland Cement Concrete*
*Nos. 43 & 44 Similar Concrete With .05% Vinsol Resin Interground With Cement*
*Nos. 47 & 48 Similar Concrete With .05% Beef Tallow Interground With Cement*

After the ice was completely melted (approximately 4 to 6 hours) the water or brine was drained off, the blocks again covered with one-half pint of water and returned to the cold room in the afternoon. This procedure was repeated until the blocks were deemed to have failed or until they had been subjected to 50 cycles of this freezing and thawing. At the end of each five cycles the blocks were lightly brushed with a wire brush in order to remove any loose scale. Following the brushing, each block was inspected and any change in its condition was recorded.

In Figure 2, all of the six blocks shown were untreated and were thawed in air. The top two blocks were made with a normal portland cement, the center two blocks with the same brand of portland cement with 0.05% Vinsol resin interground, and the lower two blocks the same brand of cement with 0.05% beef tallow interground. It will be noted, of course, that the bottom four blocks are still in very good condition while the two blocks at the top which were made without any air-entrainment are beginning to scale and to expose particles of coarse aggregate. The bottom four blocks were subjected to 50 cycles of freezing and thawing, while of the top two blocks, No. 91 was removed from test at the end of 43 cycles, and Block No. 92 at the end of 38 cycles.

Figure 3 shows concrete blocks made of the same materials as in Figure 2. However, in this case the ice on the blocks was thawed with calcium chloride solution as previously described (at the rate of 2 lbs. dry chloride per square yard). Block No. 93 was removed from test at the end of 24 cycles, Block No.

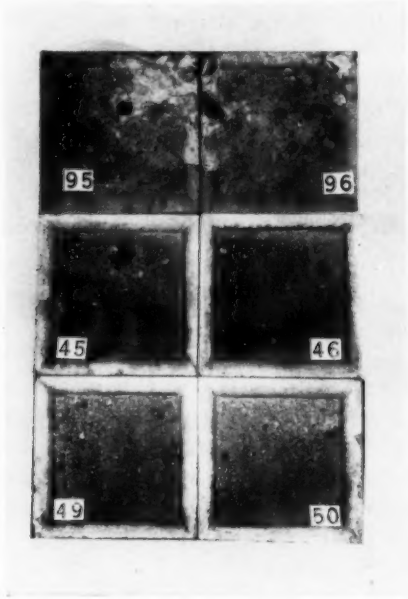


FIGURE 4

RESISTANCE TO NATURAL FREEZING AND THAWING WITH SODIUM CHLORIDE (2 POUNDS PER SQUARE YARD).

*Nos. 95 & 96 Normal Portland Cement Concrete*
*Nos. 45 & 46 Similar Concrete With .05% Vinsol Resin Interground With Cement*
*Nos. 49 & 50 Similar Concrete With .05% Beef Tallow Interground With Cement*

94 at the end of 32 cycles, while Blocks Nos. 43, 44, 47 and 48 were subjected to 50 cycles. All blocks were photographed when tests on them were completed. The lower four blocks, made of air-entrained concrete, have scaled slightly, and some pitting has occurred due primarily to soft particles in the aggregate. These soft particles were principally shale, although two pieces of argillaceous limestone were also exposed.

Figure 4 again shows the same combination of cement with and without air-entrainment as the previous Figures. All of these blocks were thawed with sodium chloride. Numbers 95 and 96 which contained no air-entraining agents were removed from test at 18 and 17 cycles respectively. The lower four blocks were removed from test at 50 cycles when these pictures were taken. Again there was some slight scaling and pitting due to aggregate, the aggregate causing the pitting in this case being chert, black shale and limonite.

At the time these blocks were made we did not know the value of determining the quantity of air entrained, and therefore do not know just what the air contents of these specimens were. However, since the cement used in these blocks happens to be the same as that used on the Test Road, we believe

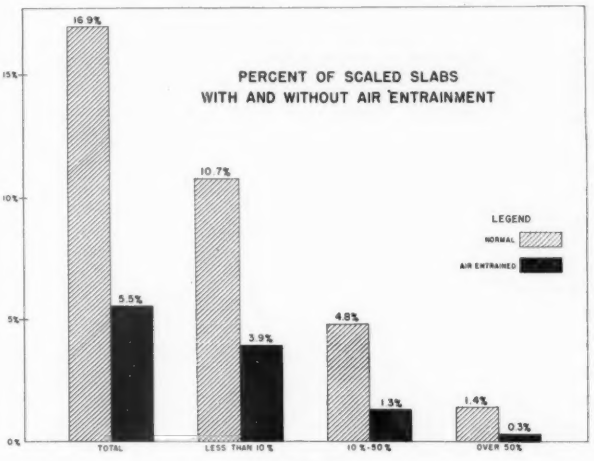


FIGURE 5

COMPARISON OF PERCENT OF SCALED CONCRETE PAVEMENT SLABS MADE WITH NORMAL AND AIR ENTRAINED CONCRETE.

that the air entrained in this concrete is approximately 4 to 5%.

Before proceeding to further discussion of air-entrainment, I would like to emphasize that we do not consider air-entrainment to be a cure-all. I think that these examples amply demonstrate that air-entrainment does not eliminate the popouts and pitting due to shale, chert and limonite, although it does minimize or retard them. In other words, air-entrainment should not be depended upon to compensate for inferior or unsatisfactory aggregate.

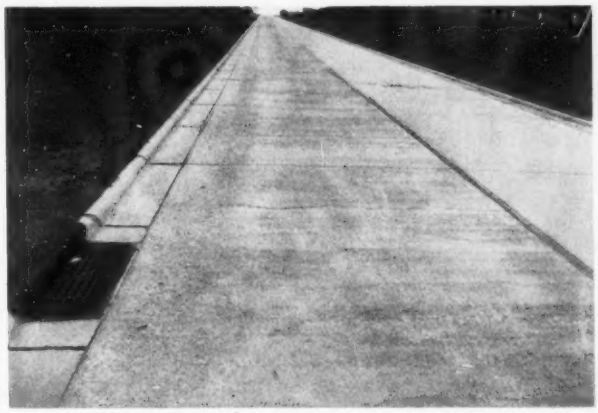

FIGURE 6

SHOWING THE PRESENCE OF SCALE ON NON AIR ENTRAINED CONCRETE AS COMPARED TO AIR ENTRAINED CONCRETE.

The results of these tests, together with the results obtained on our Test Road, both of which indicated increased resistance to the deleterious results of the use of chemicals for snow and ice removal, and, in the case of the Test Road, to increased resistance to disruptive freezing and thawing action in general, caused our Highway Department to place under contract early in 1942 four pavement projects in which Vinsol resin cement was specified to be used in the concrete. The following winter, increasing public demand for safe driving conditions resulted in the use of more chemicals for ice removal than before with a resulting increase in the amount of surface scale on our pavements.

Therefore, early in 1943 our Department issued change orders requiring the use of Vinsol resin cement on all pavements then under contract which were not at that time virtually completed. All pavement contracts let since have also required the use of air-entrained concrete.

At the time these change orders were issued, WPB Order No. L-179 covering the manufacture of cement was in force, and since we could not under this order require the cement to be manufactured with an inter ground air-entraining agent, we provided in our Specifications that if Vinsol resin cement was not

furnished that the Contractor would be required to add a sufficient amount of Vinsol resin-sodium hydroxide-water solution to cause a 3 to 5 pound reduction in the unit weight of the concrete when compared to similar concrete with no air-entraining

FIGURE 7

SCALING AND RAVELING ALONG LONGITUDINAL JOINT BETWEEN NORMAL AND AIR ENTRAINED CONCRETE.

agent. By January 1, 1945 we had completed 67 projects in which either Vinsol resin or neutralized Vinsol resin solution added at the mixer were used to provide air-entrainment. Some of these projects were built using 6 sacks of cement per cubic yard and some using 6½ sacks per cubic yard, since in August of 1943 we increased our minimum cement factor from 6 sacks per cubic yard to 6½ sacks per cubic yard and at the same time reduced the maximum water-cement ratio from 6 gallons per bag of cement to 5½ gallons per bag. Also at this time, the percentage of fines required in concrete fine aggregate was increased to provide a minimum of 14% passing a No. 50 sieve. Both of these changes were made in an attempt to obtain more durable concrete.

Since 7 of the 67 jobs built during this two-year period (1943 and 1944) were quite small they were not included in a survey of our air-entrained concrete projects which we made last summer. The sixty projects included in the survey involved approximately 600,000 barrels of either Vinsol resin cement or of normal portland cement with the neutralized Vinsol resin solution as an admixture. If the concrete surveyed was placed as a single lane it would be approximately 235 miles in length.

In obtaining our data, we calculated the total number of slabs in each project and tabulated the number of slabs which were scaled. The scaled slabs for tabulation purposes were divided into three classifications: those having less than 10% of the surface scaled, those having 10 to 50% of the surface scaled, and those having over 50% of the surface scaled. When the number of individual slabs in all projects were totaled they amounted to 59,475 slabs.

Of these 59,475 slabs, 3,292 slabs or 5.5% of all the slabs inspected were found to be scaled to various degrees. This 5.5% of scaled slabs can be broken down as follows: 3.9% were scaled less than 10%, 1.3% 10 to 50% and 0.3% were scaled over 50%.

In an effort to evaluate these data and to determine what decrease, if any, in scaling had resulted from the use of air-entrainment, it was finally decided to compare these scaling data with similar data obtained by another survey made in 1943. The 1943 survey covered concrete placed from 1936 to 1942, inclusive. However, since the air-entrained concrete was either one or two years old, only the concrete placed in 1941 and 1942 was used for comparison purposes. It was our thought that in selecting these two years we would not be giving any break to the air-entrained concrete since the winter of 1944-1945 was one of the most severe winters which we have experienced. In 1945, while looking over some of the jobs which we had previously surveyed, we

FIGURE 8

SCALED BRIDGE DECK AND APPROACH SLAB MADE OF NORMAL CONCRETE, ADJACENT PAVEMENT AIR ENTRAINED CONCRETE.

learned that some jobs which were several years old and had not scaled before, scaled during that winter. This was most interesting as well as disillusioning, since we had reached a tentative conclusion that concrete which had gone through several years with-

out scaling would in most cases be fairly immune to the action of freezing and thawing and to the use of chemicals for ice removal.

The concrete pavements built in 1941 and 1942 were equivalent to approximately 322 lane miles of pavement, and were made up of 36,530 individual slabs. The slabs in the 1941 and 1942 concrete were usually 60 feet long since at that time our concrete pavements were built generally with steel reinforcement. During 1943 and 1944, due to the shortage of steel, practically all of our concrete was of non-reinforced design and the slabs were generally 20 feet in length.

Of the 36,530 slabs in the 1941 and 1942 concrete, 6,173 slabs or 16.9% of the total were scaled. This 16.9% can be broken down as follows: 10.7% were scaled less than 10%, 4.8% 10 to 50% and 1.4% were scaled over 50%.

A comparison of the data from the two surveys (Figure 5) reveals that the per cent of scaled slabs on the air-entrained concrete is approximately one-third of that on the non-air-entrained concrete. This comparison is even more striking when we consider the percentage of slabs which are scaled in excess of 50%, where on the air-entrained concrete we have approximately one-fifth of the percentage of scaled slabs as on the concrete made without entrained air,

FIGURE 9

COMPARISON OF SCALE RESISTANCE OF CONCRETE MADE WITH TWO BRANDS OF AIR ENTRAINING CEMENT.

and in the case of the 10 to 50% scaled slabs, where we have approximately one-fourth of the percentage of scaled slabs.

I would like to point out that although these data are not directly comparable since the two groups of pavement were not placed by the same equipment and contractors and using identical aggregates as an experimental pavement would have been, we do know that many of the same materials were used in 1941 and 1942 as were used in 1943 and 1944 and that

FIGURE 10

SCALE ON AIR ENTRAINED CONCRETE. ENTRAINED AIR NOT OVER TWO PERCENT.

all of this pavement was placed using equipment and practices meeting our current construction specifications.

We believe these statistics indicate that there is a definite increase in resistance to scaling of our concrete due to the use of air-entrainment.

It should be borne in mind that at this time air-entraining cement was made by intergrinding from .025 to .045 per cent dry Vinsol resin. In quite a number of the projects where cement interground with the dry Vinsol resin was used we are reasonably sure that we did not have our desired minimum of 3% entrained air. This conclusion is based on the fact that in quite a number of cases when the concrete unit weights obtained on these projects were compared to unit weights on other projects using the same materials, the indicated reduction in weight was less than 3 pounds per cubic foot, while many of the neutralized Vinsol resin solution jobs had a minimum reduction in unit weight of three pounds, it being our conviction at that time that such a reduction would provide ample air-entrainment. I think that if we were to rebuild these jobs at the present time, we would probably adjust our mix and solution so as to provide a reduction in unit weight of not less than 4 pounds and preferably 5 pounds per cubic foot and would therefore expect an even greater resistance to scaling.

While statistics indicate a marked increase in the durability of concrete based on resistance to scaling and to freezing and thawing, this increased resistance can probably be illustrated best by pictures. In the following figures an attempt will be made to demonstrate the benefits which have been derived from the use of air-entrainment.

FIGURE 11
SCALED BRIDGE DECK MADE OF NORMAL CONCRETE, ADJACENT PAVEMENT, AIR ENTRAINED CONCRETE.

In Figure 6 is seen one of the projects on which we issued a change order early in 1943, after concreting operations had begun, requiring the use either of air-entraining cement or a neutralized Vinsol resin solution. The project is located on U. S. Route 42, north of Ashland and has a traffic count of approximately 2,000 vehicles per day. The unscaled lane and the gutter section were built with an air-entraining cement while the scaled lane was built using the same brand of cement without any air-entraining agent either added or interground. Slag coarse aggregate was used with both types of cement as was natural sand for the fine aggregate. The natural sand used with the normal portland cement, however, was from a different source than that used with the air-entraining cement. The normal portland cement concrete was placed in 1942 and the air-entraining cement concrete in 1943. There was no traffic on the normal portland cement concrete during the winter of 1942-1943 and it consequently received no chemical treatment. This pavement was placed as one roadway of a divided pavement project. During the severe winter of 1944-1945 the other roadway was closed to traffic and all of the traffic was concentrated on this one strip.

Figure 7 is a closeup taken along the longitudinal joint between the normal portland cement concrete and the air-entraining portland cement concrete. You will notice that in addition to the scale on the normal cement section, there is also some chipping and raveling along the longitudinal joint which is not present on the air-entrained concrete.

Figure 8 was taken on a project located in the Akron area, on U. S. Route 224, the approach to the Goodyear Aircraft Corp. This pavement has a traffic count of approximately 8,000 vehicles daily. It compares air-entraining portland cement concrete pavement with a non-air-entraining portland cement concrete bridge deck. The scaling in this case stops at the joint located between the approach slab to the bridge deck, and the concrete pavement proper. At least 50% of the area of the bridge deck is scaled. The pavement, involving some 2,500 slabs, had 8 scaled slabs. Natural sand and gravel coarse aggregate, both from the same source, were used in both the bridge deck and the concrete pavement. The air-entraining portland cement, however, was not from the same mill that produced the normal portland cement used in the deck.

Figure 9 is a view of a job which was built adjoining the one in Figure 8. It was built in 1944 of the same fine and coarse aggregate as the previous job and part of it with the same air-entraining cement. The concrete shown on the left and in the median wedge was made using Vinsol resin cement from one mill. The concrete on the right was made using another brand of air-entraining cement, and is scaled in the wheel tracks to a point about opposite the far end of the clump of trees on the right. From this point on, the same brand of cement used in the left lane and median strip was used in both lanes. The concrete similar to that at the right has approximately one half of its slabs scaled, some as much as 50%. The concrete represented in the left of this picture has only about 3% of scaled slabs, all of which are scaled less than 10%.

Figure 10 was taken on a project on S. R. 165 near the Pennsylvania line in the northeastern part of the State. This project is a cut-off on the main route from Pittsburgh to Cleveland and as a result carries some very heavy truck traffic. It has a traffic count of approximately 4800 vehicles daily. One brand of cement and the same fine and coarse aggregate were used throughout the project. Both fine and coarse aggregates were limestone. The project was built in two 11-foot lanes and since the scale was confined to the right lane of the pavement, we studied our

records to see if this scaling could be accounted for. Calculations made on mix data from the concrete inspectors' daily reports on this project, which are submitted daily to the Laboratory, indicate that by gravimetric determination, the air content of the concrete involved in the project was divided into two distinct groups. In one group the air content ranged from about 1 to 2% while in the other group the air content ranged from about 2½ to 3½%. When these air contents were plotted against the scale, it revealed the fact that the scaling was all confined to the concrete which had the lower air content. Further investigation showed that the cement was shipped from two different bins and that the cement developing the low air content was made using dry Vinsol resin in such quantities as to meet our Specification requirements of .025 to .045% of Vinsol resin. The cement in the other bin was made using neutralized Vinsol resin, approximately .025% by weight of cement. Needless to say, our future Specifications will require the use of neutralized Vinsol resin, when Vinsol resin is to be used as the air-entraining agent interground with the cement.

Better control of the amount of air entrained in the concrete can probably be obtained when admixtures are used, since the quantity of air which will be entrained is dependent upon other factors in addition to the amount of air-entraining agent used. Such other factors include the type and gradation of the aggregates, the richness of the mix, the mixing time, the consistency of the concrete and the type and condition of the mixer.

As mentioned previously, we have now reached the conclusion that perhaps the reduction in our unit weight when using neutralized Vinsol resin solution was not as great as is necessary. However, even in those cases where the unit weight reduction was not enough to eliminate or greatly reduce the scale, it still was enough to minimize it. This, I believe can be illustrated by Figure 11. This project, the James Road project, was built as an approach to the Columbus Service Forces Depot and the Curtiss-Wright Airplane Corp. Plant at the east edge of Columbus and has a traffic count of approximately 9900 vehicles daily. In the foreground is a bridge deck while back of the black line is the approach slab and concrete pavement. The bridge deck and approach slab are made of non-air-entraining portland cement concrete. The adjacent pavement is made of concrete using a normal portland cement with neutralized Vinsol resin solution as the air-entraining agent. The scaling on the structure covers approximately 50% of its area and is appreciably deeper than that of the scale on the pavement. The same brand of normal cement, the same limestone coarse aggregate and the same natural sand fine aggregates were used in both cases. Comparison of the unit weights of the air-entrained concrete incorporated in this project with that of similar concrete made without the air-entraining solution indicates that the amount of air entrained was probably not in excess of 2 to 2½%. It is thought, however, that much of this scaling could have been eliminated, and will be on future admix jobs, if sufficient solution is used to obtain a unit weight reduction of at least 5 pounds.

Figure 12 is a view of the concrete pavement built on the Miami and Erie Canal Road, just to the north of Cincinnati as an Access to the Wright Airplane Engine Plant. It carries 13,000 vehicles per day. The concrete was placed in 1942 and 1943, the 1943 concrete all being made with neutralized Vinsol resin solution. Except for one or two small isolated spots there is no scale on the air-entrained concrete. Figure 13 shows one of those spots, a single slab which is pretty generally scaled. It would seem likely that the Vinsol resin solution may have been omitted

FIGURE 12

AIR ENTRAINED CONCRETE PAVEMENT (NEUTRALIZED VINSOL RESIN SOLUTION) IN FOREGROUND. SCALED PAVEMENT IS NORMAL CONCRETE.

from the concrete batch used in this slab, since the scaled area is approximately that which one batch would cover.

This danger, i.e. that the solution may have been omitted, is one of the more important reasons why many Engineers prefer to use air-entraining portland cements rather than admixtures. When the air-entraining agent is added at the mixer, an automatic

dispensing device must be used, or the admixture must be added by a workman under supervision. The human element may lead to mistakes or omissions.

All the projects which we have been discussing in this 1943 and 1944 period were built either with Vinsol resin interground cement or a Vinsol-resin solution. In addition to these, one project was built on U. S. Rt. 25 in the City of Toledo, during the summer of 1944 as an experimental project. This pavement has a traffic count of approximately 15,000 vehicles per day, much of it heavy truck traffic, and passes under 8 different railroad crossings in its approximately .9 mile length. This project (Figure 14) had both Vinsol resin solution and HP-7, a patented air-entraining agent manufactured by the Master Builders Company of Cleveland, added at the mixer. The concrete on this project was placed in four 10-foot lanes. The two westbound lanes were placed with the Vinsol resin admixture and the two eastbound lanes with the HP-7 admixture. The only exceptions to this are that on the inside westbound lane, approximately 75 feet of non-air-entrained concrete was placed and on the outer eastbound lane about 70 more feet of non-air-entrained concrete was placed. These short sections were placed to provide control in the unit weight reductions of the admixture sections. There are on each of the air-entrained sections one or two small areas of scale not exceeding two or three square feet in total, while the plain concrete slabs, as shown in Figure 14, are scaled in some cases up to as much as 50%. The air content, computed in the field on this project, by following batches directly from the batcher to the project, indicates that the air entrained in both of the admixture sections was approximately 3%. The cement used was all from one bin, the fine aggregate was a natural sand and the coarse aggregate was limestone.

FIGURE 13

NEUTRALIZED VINSOL RESIN SOLUTION CONCRETE. WAS SOLUTION OMITTED FROM THIS BATCH?

I believe it will be agreed that these pictures illustrate the point which I previously made: That there is a decrease in scale with the use of air-entrained concrete. We believe, however, that repeated and excessive use of chemicals for ice removal might eventually scale even the best of these jobs. We also recognize that snow and ice create hazardous conditions for traffic, oftentimes in the nature of emergencies, and makes the use of chemicals necessary to insure the safety of the traveling public. However, since repeated freezing and thawing of the concrete in contact with chemicals appears to be conducive to surface pitting and scaling, we believe that when the use of chemicals is necessary for the safety of the traveling public, they should be used as sparingly as possible.

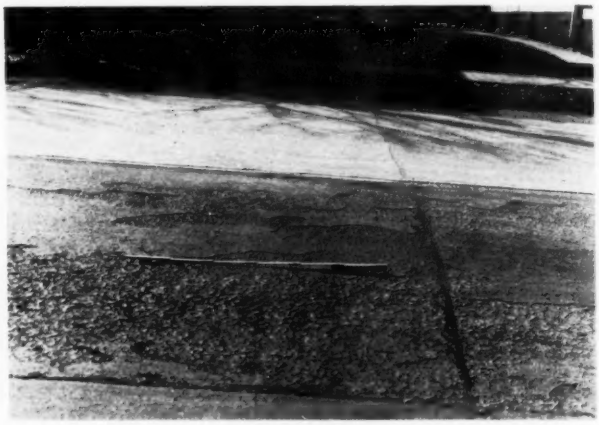

FIGURE 14

EXPERIMENT PAVEMENT. NORMAL CONCRETE SHOWING EXTENSIVE SCALE IN FOREGROUND. HP-7 USED AS AIR ENTRAINING AGENT IN CONCRETE SHOWN IN BACKGROUND.

I have pointed out that we believe a minimum of 3% air should be specified for air-entrained concrete. During the past summer a meeting was held at our Laboratory with representatives of all the cement

companies furnishing air-entraining cement to State projects. At this meeting the minimum air content was discussed with the cement company representatives present and as a result our new Specifications will require an air-entrainment of 16 plus or minus 4% air when the air-entraining portland cement is tested in the A. S. T. M. mortar test.

During 1945 we changed our Specifications so that air-entraining cement would be required not only in concrete pavements, but in concrete bases, structures and other incidental items. This change was made because we believe that while air-entrainment does not overcome the deleterious effect of questionable materials or of poor construction practices, it does improve the durability or resistance to chemicals and to freezing and thawing.

New Specifications which are now being prepared will require the entrainment of from 3 to 6% air in the concrete. This entrainment may be obtained either through the use of cement with an interground air-entraining agent or by means of an air-entraining agent added to the concrete at the mixer. It is our intent to determine in the field, by volumetric measurement, the amount of air entrained. We have been using the gravimetric method to determine air content, but believe that the volumetric measurement will prove more satisfactory. Using the gravimetric method, it is generally necessary to follow an individual batch from the batching plant through the mixer and make the determination on that batch. In order to accurately make such a determination, samples of the aggregate must be taken at the batching plant from the batch upon which the weight determinations are finally made. This becomes quite involved if there are a large number of jobs to cover, so as a means of control we intend, as has been previously stated, to determine the air content volumetrically and then to maintain the concrete mix with the same slump and proportions as were used in determining the air content.

All of our experience to date can probably be summed up as follows:

1. That in order to obtain greatly increased resistance to freezing and thawing and to scaling, the per cent of entrained air should be specified to be not less than 3%. The maximum amount of air can safely be set at 6%, since our data does not indicate any flexural failure due to reduction in strength at this percentage. I believe that if similar data from other States or agencies are checked the same general trend of setting the required air content from 3% to 6% will be found.
2. Air-entrainment, while it retards scaling and disintegration due to poor material, is not a cure-all. It is suggested that only the best cements and aggregates commercially available should be used in the manufacture of air-entrained concrete.
3. The use of air-entrainment does not compensate for poor construction practices. While the use of air-entrainment greatly reduces the amount of sedimentation or bleeding occurring in the field, it does not compensate for poor handling of materials or improper proportioning. This reduction in sedimentation or bleeding results in little free water on the surface for lubrication during finishing operations and necessitates that the finishers follow closely behind the finishing machine. This generally eliminates most of the late finishing which is so often prevalent. While generally segregation is materially reduced by air-entrainment, this is not always true, especially when such concrete is delivered by chutes. Observations on numerous projects using concrete mixed in transit indicate that the segregation of mortar from the coarse aggregate is often increased. In order to eliminate this segregation, it is suggested that the use of baffle plates either in or at the bottom of the chute should be employed.

If these suggestions are made a part of our regular concrete practice, we feel that another step has been taken along the road to a truly durable, resistant concrete.

## Agricultural Limestone and Its Place in A.A.A.'s Postwar Program

(*Continued from Page 22*)

grassland will be the answer to the problem of increasing meat production . . . and it will be meat produced at a profit to the farmer and at a price that all income groups can afford and it will also contribute to the over-all conservation of the nation's soils. You are wondering how that affects the liming materials industry . . . the program should be history making in your industry . . . gentlemen . . . millions of acres of sorely depleted soil coming back to grass and legumes will need lime . . . if all this land were to be converted at one time, it would require more lime than was produced in the entire United States during 1944 . . . gentlemen . . . this is your postwar project and our postwar problem. . . . Let's hope we both come through with flying colors.

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